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FEASIBILITY STUDY OF ADDITIONAL SITE-WIDE REMEDIAL ALTERNATIVES FOR THE ESTUARY AND LOWER HARBOR/BAY

NEW BEDFORD HARBOR
MASSACHUSETTS

VOLUME III
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ESTUARY AND LOWER HARBOR/BAY FEASIBILITY STUDY
NEW BEDFORD HARBOR, MASSACHUSETTS

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EXECUTIVE SUMMARY

This document presents three additional site-wide remedial alternatives to address potential threats to human health and the environment caused by PCB contamination in the sediment and water column of the Acushnet River Estuary (excluding the Hot Spot) and the lower New Bedford Harbor and upper Buzzards Bay. These alternatives provide a site-wide cleanup strategy by combining non-removal and removal technologies for both the estuary and the lower harbor/bay.

In 1986, EPA Region I began a feasibility study (FS) of remedial alternatives for New Bedford Harbor under the REM III Superfund Program. Because New Bedford Harbor is a large and complex site, EPA Region I divided the FS into two operable units in 1989: the Hot Spot Area, and the Estuary and Lower Harbor/Bay. An FS of remedial alternatives for the Hot Spot Area was prepared and submitted to EPA Region I in July 1989. EPA signed a Record of Decision documenting its selected remedy for the Hot Spot in April 1990. A more detailed discussion of the New Bedford Harbor site and the FS is presented in Volume I.

Volume II of this FS presents remedial alternatives developed and evaluated for the Estuary (excluding the Hot Spot Area) and Lower Harbor/Bay operable unit. Consistent with Superfund program requirements, the alternatives for the estuary and for the lower harbor/bay include minimal no action, on-site containment of contaminated sediment, and sediment removal and subsequent treatment. A residual sediment PCB concentration of 10 ppm was examined as a target cleanup level (TCL) believed to be protective for both the estuary and the lower harbor/bay. The rationale for this TCL is presented in Sections 3.0 and 4.0 of Volume I.

The six remedial alternatives which were evaluated in Volume II would require the remediation of an extremely large volume of sediment in order to achieve a 10 ppm TCL. In addition, these same alternatives require a substantial amount of land for siting associated water and sediment treatment and/or disposal facilities. The limited amount of suitably located, undeveloped land currently available, combined with competing present and future land development interests of commercial, recreational, and/or municipal groups, presents a potentially serious problem in implementing these remedial alternatives.

In an attempt to explore possible solutions to these and other problems, EPA has developed and evaluated three additional site-wide alternatives which are presented in this Volume. In addition, EPA has examined an alternative sediment PCB target cleanup level (TCL) of 50 ppm in evaluating these additional site-wide alternatives. EPA believes that a PCB TCL of 50 ppm will provide an adequate level of protection to human health via direct contact exposure with contaminated sediment. The 10 ppm TCL was developed to be protective of repetitive exposure incurred by a young child (ages 0-6 years) and was based on achieving a residual risk level of $1x10^{-5}$. At 50 ppm the residual risk for a young child increases to $5x10^{-5}$. This risk level is still within the EPA target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Potential adverse effects to biota resulting from exposure to residual PCBs following cleanup to 10 ppm and 50 ppm was assessed using the joint probability analysis methodology developed for the New Bedford Harbor Ecological Risk Asssessment (E.C. Jordan Co./Ebasco, 1990a) and the results of the TEMPEST/FLESCOT model (Battelle, 1990). The results of this assesesment indicated that there was no demonstrable difference in the percentages of marine fish, crustaceans and mollusks whose maximum acceptable toxicant concentrations (MATCs) would be exceeded due to exposure to water column or sediment PCB concentrations following remediation to a 50 ppm TCL versus remediation to a 10 ppm TCL. Aquatic biota exceeding their MATCs would be expected to be adversely impacted in terms of growth, reproduction and survival.

The three site-wide remedial alternatives evaluated in this Volume are presented in Table E-1. These alternatives were evaluated according to the following nine NCP evaluation criteria:

- short-term effectiveness
- long-term effectiveness
- reduction in mobility, toxicity, or volume
- implementability
- cost
- compliance with ARARs
- overall protection of public health and the environment
- state acceptance
- community acceptance

The first seven criteria were also used to evaluate the site-wide alternatives relative to one another in the comparative analysis of alternatives. Table ES-2 summarizes results of the comparative analysis. Comparative costs of the site-wide remedial alternatives for the estuary and lower harbor/bay operable unit are shown in Figure ES-1.

TABLE ES-1

SITE-WIDE REMEDIAL ALTERNATIVES
FOR THE
ESTUARY AND LOWER HARBOR/BAY
NEW BEDFORD HARBOR

SITE-WIDE ALTERNATIVE 7 (SW-7)

Estuary	o Dredge 112,000 cy of sediment containing PCBs >500 ppm o Dispose untreated dredged sediment in CDF 1 o Cap 77 acres of sediment containing 50 ppm to 500 ppm PCBs
Lower Harbor/Bay	o Minimal no action (long-term monitoring only)

SITE-WIDE ALTERNATIVE 8 (SW-8)

Estuary	o Dredge 232,000 cy of sediment containing PCBs >50 ppm o Dispose untreated dredged sediment in CDFs 1, 1a, and 3
Lower Harbor/Bay	o Dredge 76,000 cy of sediment containing PCBs >50 ppm o Dispose untreated dredged sediment in CDFs 1, 1a, and 3

SITE-WIDE ALTERNATIVE 9 (SW-9)

Estuary	o Dredge 232,000 cy of sediment containing PCBs >50 ppm o Treat 112,000 cy of sediment containing PCBs >500 ppm o Dispose treated and untreated sediment in CDFs 1 and 1b.
Lower Harbor/Bay	o Dredge 76,000 cy of sediment containing PCBs >50 ppm o Dispose untreated dredged sediment in CDFs 1 and 1b

TABLE ES-2
SUMMARY OF THE COMPARATIVE ANALYSIS OF THE ADDITIONAL SITE-WIDE REMEDIAL ALTERNATIVES
ESTUARY AND LOWER HARBOR/BAY FEASIBILITY STUDY

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
Reduction of toxicity, mobility, or volume.	No reduction in toxicity, mobility, or volume. Containment of contaminated sediment in CDFs or via capping is expected to reduce the potential migration of PCBs and metals.	No reduction in toxicity, mobility, or volume. Containment of contaminated sediment in CDFs is expected to reduce the potential migration of PCBs and metals.	Reduction in toxicity, mobility and volume of PCBs in sediments containing >500 ppm PCBs which are treated via incineration or solvent extraction. Volume of treated residue increased by solidification. Containment of untreated contaminated sediment is expected to reduce the potential migration PCBs and metals.
Short-term Effectiveness			
o Time until protection is achieved	Reduction in human health risk should occur immediately after cap placement and consolidation, and removal of sediment for disposal in CDFs. Significant reduction in water column PCB concentrations. Time required to achieve protection of biota depends on benthic recolonization of new cap surface.	Reduction in human health risk should occur immediately following sediment removal. Significant reduction in water column PCB concentrations and subsequent reduction in biota.	Same as Alternative SW-8
o Protection of Community during Remedial Actions.	No impact is expected to the community during capping activities. Dredge controls and air quality controls would minimize community impacts during dredging and CDF disposal operations.	Dredge controls and air quality controls would minimize community impacts during dredging and CDF disposal operations.	Same as Alternative SW-8

TABLE ES-2
Continued

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
o Protection of Workers during Remedial Actions.	Minimal risk to workers during capping activities. Protection required against normal contact with dredged sediments, fugitive dust and volatilized contaminants during dredging and disposal operations.	Protection required against dermal contact with dredged sediments, fugitive dust and volatized contaminants during dredging and disposal operations.	Same as Alternative SW-8. Appropriate worker protection required for both incineration and solvent extraction, and solidification of treated residue.
o Environmental Impacts	Destruction of benthic community during capping activities or sediment dredging. Sediment resuspension expected during capping activities.	Destruction of benthic community during sediment dredging. Minimal environmental impact expected from dredging or CDF construction.	Same as Alterntive SW-8
Long Term Effectivness			
o Magnitude of Residual Risk	Potential risks remain because contaminated sediment remains on site under cap or stored in shoreline CDFs.	Potential risks remain became contaminated sediment remains on site in shoreline CDFs	Same as Alternative SW-8, Minimal risks remain for treatment of sediment with PCBs >500 ppm.
o Adequacy of Controls	Annual monitoring and maintenance of cap and CDF is required. CDF construction is well-proven.	CDF construction is well-proven. Annual monitoring and maintenance would be required.	Same as Alternaive SW-8. No special provisions for long-term management of treatment residuals is expected.

TABLE ES-2
Continued

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
o Reliability of Controls	Reliability concerns due to potential for cap failure or disturbance. Likelihood of CDF failure is minimized as long as regular monitoring and maintenance is conducted.	Likelihood of CDF failure is minimized as long as regular monitoring and maintenance is conducted.	Same as Alternative SW-8
Implementation			
o Technical Feasibility	Equipment and technology exists for capping. However, cap installation may be difficult since conventional placement techniques would need to be modified to accommodate the shallow water depths in the upper estuary. CDFs are relatively easy to implement. Dredging and CDF disposal are well-proven technologies.	CDFs are relatively easy to implement. Dredging and CDF disposal are well proven technologies.	Same as Alterntive SW-8. Incineration or solvent extraction would require special equipment and operations; treated residuals would require testing to verify treatment effectiveness. Incineration has been demonstrated at other sites. Demonstrations of full-scale solvent extraction have been limited. Technology has been demonstrated on a bench-scale to be effective at treating New Bedford Harbor sediments.
o Administrative Feasibility	Expected to be feasible. On-site remediation will negate need for permits.	Same as Alternative SW-7	Same as Alternative SW-7
o Availability of Services and Materials	Dredge cap and CDF construction services available in eastern U.S.	Dredge and CDF construction services available in eastern U.S.	Same as Alternative SW-8. Incineration equipment equipment and services available in eastern U.S.

TABLE ES-2
Continued

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
COST			
o Present Cost	$36,164,000	$33,274,000	$ 80,634,000 (SW-9A) $ 92,999,000 (SW-9)
Compliance w/ARARs	AWQC for water column PCB concentrations would not be attained at the end of ten years following remediation. FDA tolerance level for biota would not be attained in all areas. Waiver from action-specific ARAR may be required for unlined CDFs. All other ARARs would be met.	AWQC for water column PCB concentrations would be attained at the end of ten years following remediation. FDA tolerance level for biota would not be attained in all areas. Waiver from action-specific ARAR may be required for unlined CDFs. All other ARARs would be met.	Same as Alternative SW-8
Overall Protection of Human Health and the Environment	Risks to human health and the environment are reduced by minimizing contact with contaminated sediment through capping and by the removal of the sediments.	Risks to human health and the environment are reduced by minimizing contact with contaminated sediments through removal of the sediment.	Same as Alternative SW-8. Risks to human health and the environment are significantly reduced by the removal and treatment of sediments containing PCBs > 500 ppm.

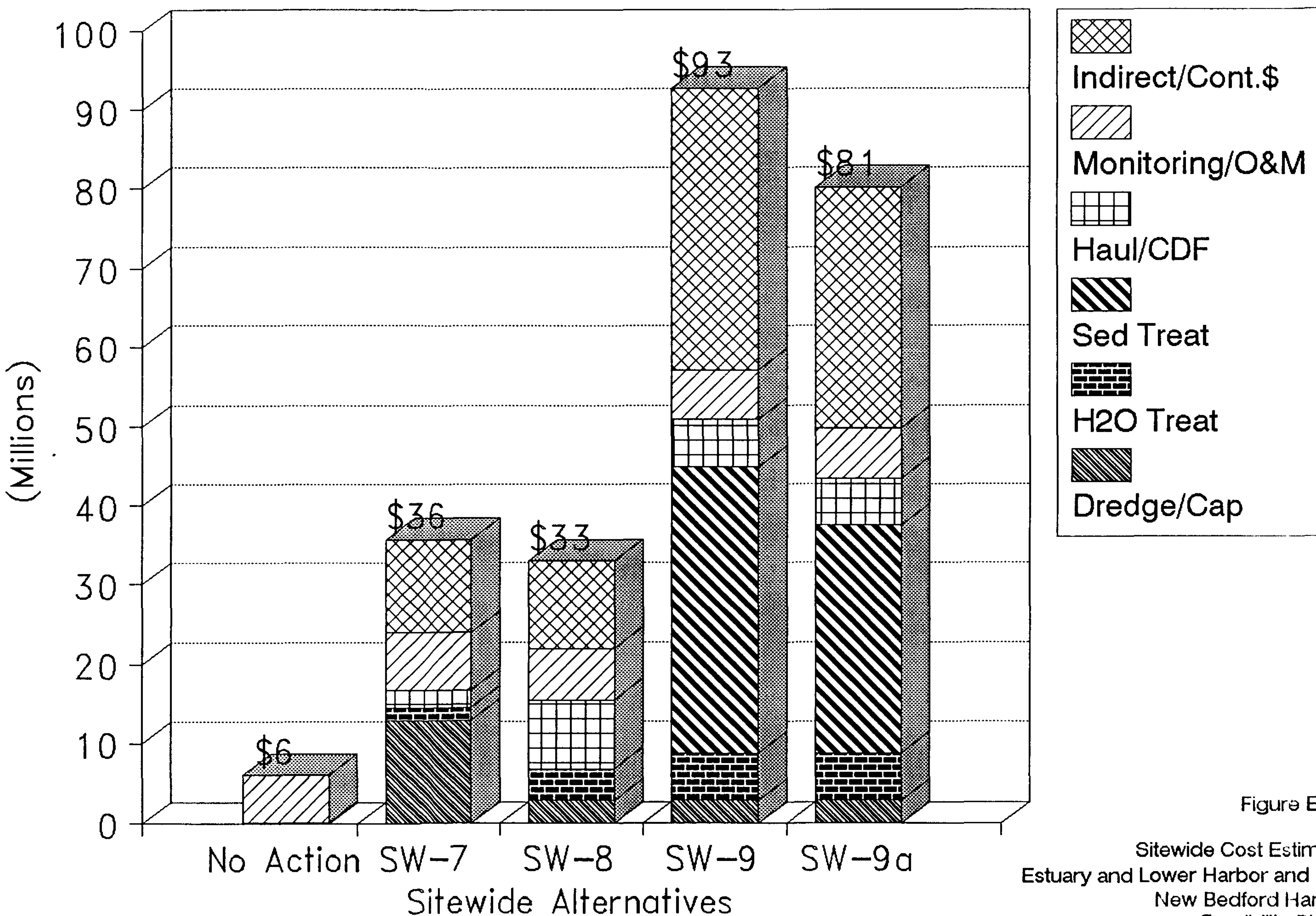

Figure ES-1

Sitewide Cost Estimate
Estuary and Lower Harbor and Bay
New Bedford Harbor
Feasibility Study

1.0 INTRODUCTION

1.1 BACKGROUND

Sediment throughout the New Bedford Harbor site is contaminated with PCBs. Numerous studies, discussed in Section 2.0 of Volume I, indicate that the greatest mass of PCBs resides in the upper estuary sediment and decreases in a southerly direction down into the lower harbor and upper Buzzards Bay. The net flux of PCBs measured at the Coggeshall Street Bridge indicates that the estuary continues to serve as a source of contamination to the remainder of the site (Teeter, 1988).

Because New Bedford Harbor is a large and complex site, EPA Region I divided the New Bedford Harbor FS into two operable units in 1989: the Hot Spot Area, and the Estuary and Lower Harbor/Bay. Descriptions of these operable units are presented in Sections 1.0 and 2.0 of Volume I.

An FS of remedial alternatives for the Hot Spot Area was prepared and submitted to EPA Region I in July 1989. EPA signed a Record of Decision documenting its selected remedy for the Hot Spot in April 1990. The selected remedy consists of the removal of approximately 10,000 cy of contaminated sediment followed by on-site incineration, solidification of the residue if necessary, and temporary storage of the treated sediment in a shoreline confined disposal facility. Remedial design activities for the Hot Spot are currently underway.

Volume II of this FS presents remedial alternatives developed and evaluated for the Estuary (excluding the Hot Spot Area) and Lower Harbor/Bay operable unit. Consistent with Superfund program requirements, the alternatives for the estuary and for the lower harbor/bay include minimal no action, on-site containment of contaminated sediment, and sediment removal and subsequent treatment. A residual sediment PCB concentration of 10 ppm was examined as a target cleanup level (TCL) believed to be protective for both the estuary and the lower harbor/bay. The rationale for this TCL is presented in Sections 3.0 and 4.0 of Volume I.

1.2 DEVELOPMENT OF ADDITIONAL SITE-WIDE ALTERNATIVES

As noted above, New Bedford Harbor is a large and complex site. In Volume II of this FS, six remedial alternatives were evaluated to address the areal extent of the sediment PCB contamination in the estuary and the lower harbor/bay and the resulting risks to human health and aquatic biota. In order to achieve a 10 ppm TCL, an extremely large volume of sediment would require remediation.

In addition, these same alternatives require a substantial amount of land for siting associated water and sediment treatment and/or disposal facilities. The limited amount of suitably located, undeveloped land currently available, combined with competing present and future land development interests of commercial, recreational, and/or municipal groups, presents a potentially serious problem in implementing these remedial alternatives.

In an attempt to explore possible solutions to these and other problems, EPA has developed and evaluated three additional site-wide alternatives which are presented in this Volume. These alternatives provide a site-wide cleanup strategy by combining non-removal and removal technologies for both the estuary and the lower harbor/bay. In addition, EPA has examined an alternative sediment PCB target cleanup level (TCL) of 50 ppm in evaluating these additional site-wide alternatives. There are several reasons that EPA chose to examine a 50 ppm TCL. EPA believes that a PCB TCL of 50 ppm will provide an adequate level of protection to human health via direct contact exposure with contaminated sediment. The 10 ppm TCL was developed to be protective of repetitive exposure incurred by a young child (ages 0-6 years) and was based on achieving a residual risk level of $1x10^{-5}$. At 50 ppm the residual risk for the young child increases to $5x10^{-5}$ based on the same exposure assumptions. This risk level is still within the EPA target risk range of $1x10^{-4}$ to $1x10^{-6}$ (NCP, FR 55(46)8666, 1990).

The incremental risks to an adult (ages 18-70 years) associated with direct contact exposure to 50 ppm PCB is $1x10^{-5}$. This risk level is based on a 10 year exposure duration, 20 exposures per year and 3.06 grams of sediment contacted per exposure. This lower risk estimate for adults is attributed to the different exposure conditions assumed for an adult and is based on a scenario of direct contact exposure to shoreline sediments. In summary, the residual risks associated with a PCB TCL of 50 ppm PCBs for the cross section of the New Bedford population ranges from $1x10^{-5}$ to $5x10^{-5}$. These risk estimates are within the target risk range of $1x10^{-4}$ to $1x10^{-6}$ and are considered appropriate for developing and evaluating remedial alternatives.

As discussed in Section 4.3.2.2 of Volume I, an ecological target cleanup level in the range of 0.1 to 1 ppm is anticipated to be protective of environmental biota. However, for the reasons discussed in Section 4.0 of Volume II, EPA does not consider a sediment PCB TCL level of 1 ppm as practicable. In contrast, a TCL of 10 ppm was considered implementable and was used for the development and detailed analysis of the six remedial alternatives in Volume II.

Potential adverse effects to biota resulting from exposure to residual sediment PCBs following cleanup to 10 ppm and 50 ppm were assessed using the joint probability analysis methodology developed for the New Bedford Harbor Ecological Risk Asssessment (E.C. Jordan Co./Ebasco, 1990a). TEMPEST/FLESCOT model (Battelle, 1990) results were used to estimate the percentage of selected marine species whose maximum acceptable toxicant concentrations (MATCs) would be exceeded due to exposure to residual water column and bed sediment PCB concentrations ten years after remediation of the estuary and lower harbor/bay to 10 ppm and 50 ppm TCLs, respectively. Aquatic biota exceeding their MATCs would be expected to be adversely impacted in terms of growth, repoduction and survival. The results of this assessment indicated that there was no demonstrable difference in the percentages of marine fish, crustaceans and mollusks whose MATCs would be exceeded due to exposure to water column or sediment PCB concentrations following remediation to a 50 ppm TCL versus remediation to a 10 ppm TCL. Therefore, EPA chose to examine additional site-wide remedial alternatives based on a 50 ppm TCL.

1.3 REMEDIATION OF WETLANDS

In addition to the nine remedial alternatives, potential remediation of a section of the saltmarsh portion of the wetlands along the eastern shoreline of the Acushnet River Estuary is addressed. Remediation of the wetlands to achieve an overall TCL of 10 ppm was discussed in Volume II. The advantages of remediating the wetlands to eliminate a potential source of PCBs which might recontaminate the estuary may not outweigh the disadvantages of losing extensive portions of the wetlands in order to achieve the 10 ppm TCL. In addition, studies conducted to characterize the diversity and productivity of the saltmarsh area concluded that no apparent adverse impacts to flora and fauna were being caused by the PCB contamination present (IEP, 1988). The issue of wetlands remediation is re-examined during the consideration of the alternative TCL of 50 ppm.

1.4 VOLUME III ORGANIZATION

This volume presents three additional site-wide alternatives for the estuary and lower harbor/bay with a PCB TCL of 50 ppm. Section 2.0 presents the detailed evaluation of these site-wide alternatives using the nine NCP evaluation criteria. Section 3.0 presents a comparison of these three site-wide alternatives.

2.0 DETAILED ANALYSIS OF SITE-WIDE ALTERNATIVES

2.1 INTRODUCTION

The development of these three site-wide alternatives is based on utilizing components of the alternatives developed for the estuary and for the lower harbor/bay. The reader is referred back to the appropriate sections for detailed descriptions of these components where applicable.

The three site-wide alternatives are summarized in Table 2-1. Detailed evaluations of these alternatives are presented in this section. Each alternative evaluation includes a description of the technologies used, the sequence of remedial activities, and graphics to depict unit process flows and equipment. The description of each alternative is followed by an assessment of the alternative with respect to the following seven NCP evaluation criteria:

- short-term effectiveness
- long-term effectiveness and permanence
- reduction of mobility, toxicity, or volume of wastes
- implementability
- cost
- compliance with ARARs
- overall protection of human health and the environment

The first five criteria address technical, cost, institutional, and risk concerns. The criterion "reduction in mobility, toxicity, or volume" refers to reduction in mobility of contaminants as a function of treatment (e.g., physical, chemical, biological or thermal). While a containment remedy may in fact reduce the migration potential of the contaminants, this is not the same standard as reduction through treatment. Compliance with ARARs and overall protection of human health and the environment are threshold criteria that reflect statutory requirements.

Two additional NCP evaluation criteria, state acceptance and community acceptance, were evaluated on the basis of information available at the time of the detailed analysis. State and community acceptance are addressed once in the following paragraphs and apply to each alternative.

<u>State Acceptance</u>. EPA has maintained continuous communications with Massachusetts state agencies (e.g., MADEP and CZM) during the New Bedford Harbor project. Representatives of these state agencies attended monthly status meetings held by EPA and reviewed many of the interim reports. Comments made by state agencies on the Estuary and Lower Harbor/Bay operable unit will be incorporated into the Responsiveness Summary and as part of the ROD process.

TABLE 2-1

SITE-WIDE REMEDIAL ALTERNATIVES
FOR THE
ESTUARY AND LOWER HARBOR/BAY
NEW BEDFORD HARBOR

SITE-WIDE ALTERNATIVE 7 (SW-7)

Estuary	o Dredge 112,000 cy of sediment containing PCBs >500 ppm o Dispose untreated dredged sediment in CDF 1 o Cap 77 acres of sediment containing 50 ppm to 500 ppm PCBs
Lower Harbor/Bay	o Minimal no action (long-term monitoring only)

SITE-WIDE ALTERNATIVE 8 (SW-8)

Estuary	o Dredge 232,000 cy of sediment containing PCBs >50 ppm o Dispose untreated dredged sediment in CDFs 1, 1a, and 3
Lower Harbor/Bay	o Dredge 76,000 cy of sediment containing PCBs >50 ppm o Dispose untreated dredged sediment in CDFs 1, 1a, and 3

SITE-WIDE ALTERNATIVE 9 (SW-9)

Estuary	o Dredge 232,000 cy of sediment containing PCBs >50 ppm o Treat 112,000 cy of sediment containing PCBs >500 ppm o Dispose treated and untreated sediment in CDFs 1 and 1b.
Lower Harbor/Bay	o Dredge 76,000 cy of sediment containing PCBs >50 ppm o Dispose untreated dredged sediment in CDFs 1 and 1b

Community Acceptance. A Community Work Group has been formed to keep members of the community informed of progress at the site. The group meets on a regular basis and has received several technical and status presentations from EPA over the last two years. The Community Work Group and the general public will have an opportunity to comment on the Estuary and Lower Harbor/Bay operable unit as part of the public review process. Comments received at that time will be incorporated into the Responsiveness Summary and as part of the ROD process.

2.2 DESCRIPTION AND ANALYSIS OF ALTERNATIVE SW-7

2.2.1 General Description

Alternative SW-7 entails dredging sediment in the estuary containing PCBs >500 ppm and disposing them in CDF 1, capping sediments between 500 ppm and 50 ppm PCBs, and conducting minimal no action in the lower harbor and upper Buzzards Bay portion of the site. An extensive monitoring program would be conducted as part of this alternative. Figure 2-1 presents a block diagram of the components for Alternative SW-7.

CDF Construction. A CDF would be constructed approximately 2000 feet north of the Coggeshall Street Bridge in the cove on the western shore (CDF 1 shown in Figure 2-2). Subsection 5.3.3 of Volume II describes CDF construction in greater detail.

Dredging. Once CDF 1 has been constructed, approximately 46 acres of sediment in the northern half of the estuary containing >500 ppm PCBs would be dredged (Figure 2-2). It is assumed that two cutterhead dredges would be employed, each dredge making two passes for a total depth of one and one half feet to remove an estimated total volume of 112,000 cubic yards (cy) of sediment. A detailed discussion of dredging is contained in Subsections 5.3.1 and 7.4.1 of Volume II. The dredged sediment slurry, consisting of 2 to 4 percent solids, would be pumped via a floating hydraulic pipeline to the CDF for disposal.

Dewatering/Water Treatment. Dredged sediment discharged to the CDF would be allowed to gravity settle. The effluent would be chemically treated to promote coagulation, flocculation and precipitation followed by either carbon adsorption or UV/oxidation treatment prior to discharge back into the estuary. These processes are described in greater detail in Subsections 5.3.2.2 and 7.4.1 of Volume II.

Disposal. Once dredging of the sediment and consolidation of the discharged sediment in the CDF has been completed, a geomembrane would be placed over the CDF followed by clean material to reduce leachate production from infiltration, contaminant volatilization and to limit the potential for dermal contact. Topsoil and seed

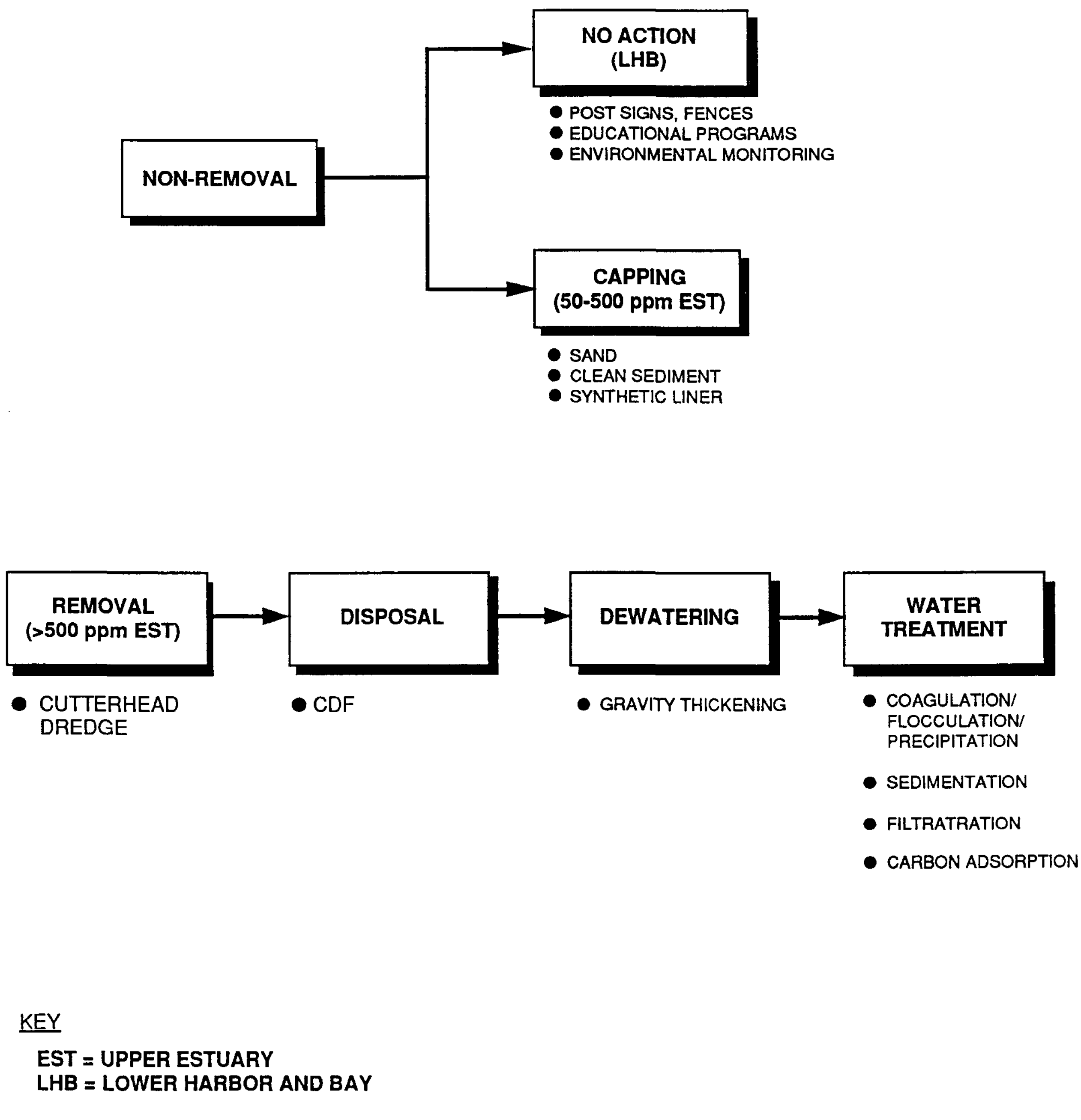

FIGURE 2-1
ALTERNATIVE SW-7
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

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would be placed over the clean cover material to prevent erosion and enhance its appearance. Figure 2-3 presents a mass balance of the dredging, dewatering, and disposal components of Alternative SW-7.

Capping. Sediment in the estuary containing PCBs 50-500 ppm would be capped using a combination of geotextile and sand as described in Subsections 5.3.4 and 7.3.1.1 of Volume II. A hydraulic control structure would be installed immediately north the Coggeshall Street Bridge and anchored to the eastern and western shorelines. Additional hydraulic controls may be placed north of the Wood Street Bridge to control flows from the Acushnet River. These controls are necessary to: (1) ensure adequate water depth within the estuary for the work barges, (2) extend the period of time the barges can work in the estuary per day, and (3) dampen the adverse affects of wave action and tidal currents during cap installation.

Following installation of hydraulic controls, cap construction would begin with the placement of geotextile over the contaminated sediment to prevent mixing of the capping material with the underlying sediment. A temporary slurry pond or similar staging area would be sited along the shoreline to hydrate the sand cap material trucked in from land-based borrow pits. Once hydrated, a dredge would pump the slurried sand to a work barge positioned in the deposition area through a floating hydraulic pipeline. The sand would be deposited over the geotextile through a diffuser or similar device designed to reduce the exit velocity of the sand. A sand cap approximately 3 feet thick would be placed over the geotextile. This would provide a minimum cap thickness of 55 cm (1.9 feet) for chemical isolation and as a biological barrier against burrowing organisms, plus an additional 1 foot of sand as a safety factor. The cap would be extended approximately 20 feet beyond the 50 ppm areal boundaries to ensure the 50 ppm TCL throughout the estuary. The edges of the cap would be completed with a 1:3 slope (vertical:horizontal) tapering to existing grade. To meet the TCL of 50 ppm in the estuary, approximately 77 acres would be capped and would require approximately 350,000 cy of clean sand. Armouring of the cap is not anticipated for SW-7 due to low erosional velocities found within this area. To ensure that a minimum 55-cm cap is placed, an extensive, continuous monitoring program would be required during construction. This program would consist of sediment coring, installation and monitoring of settlement plates, and hydrographic surveying.

Because much of the estuary bathymetry would be elevated by approximately 3 feet, the combined sewer overflows (CSOs) and other discharge lines would have to be diverted or plugged. The City of New Bedford is in the process of upgrading their sewer system. Although all CSOs would most likely not be taken out of service, a few would have to be relocated or extended through portions of the cap to prevent erosion of cap material.

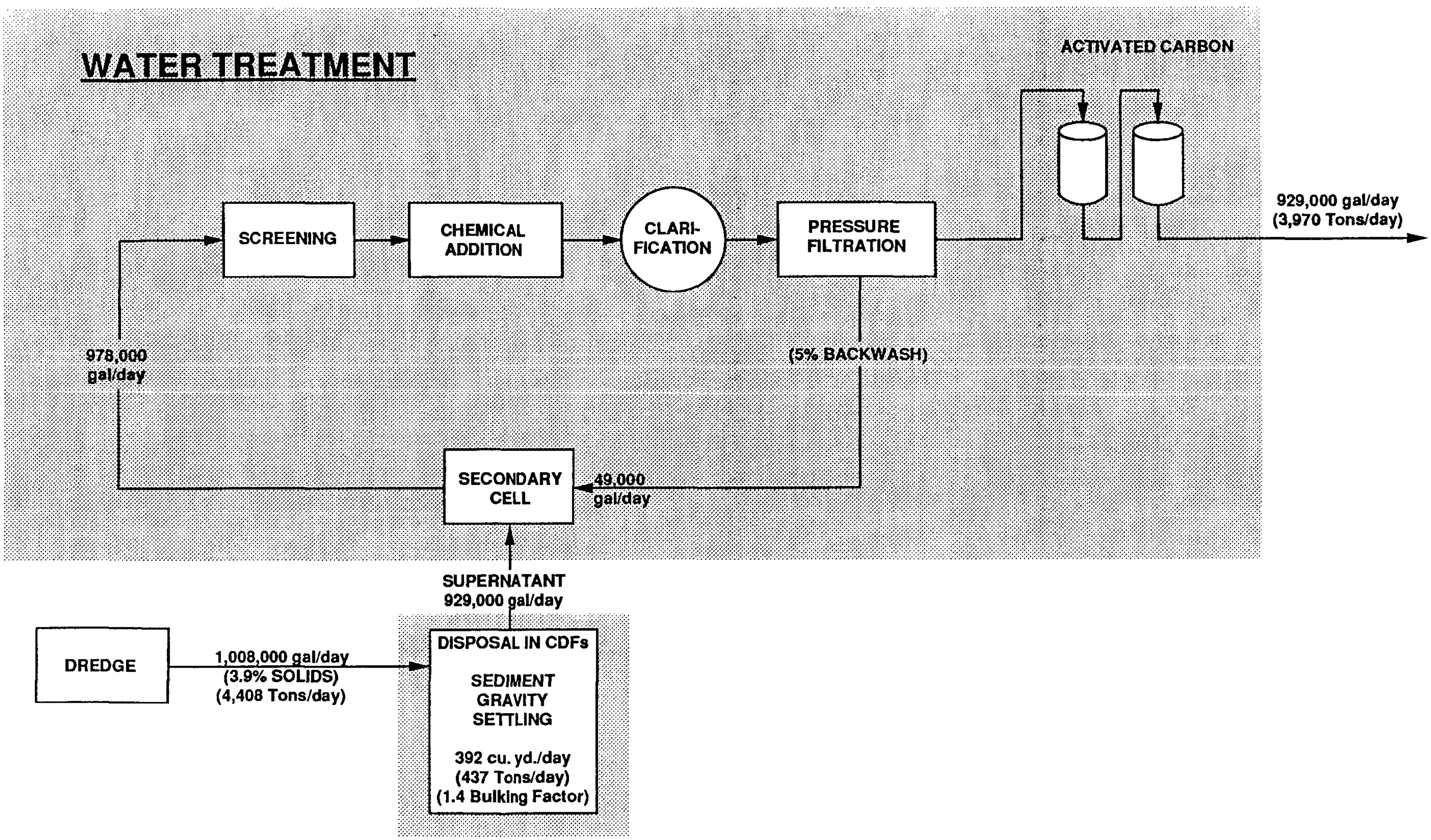

FIGURE 2-3
ALTERNATIVE SW-7: MASS BALANCE
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

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Minimal No-Action for the Lower Harbor and Bay Area. No active remediation of PCB contamination is identified for the lower harbor and bay area under the SW-7 Alternative. Instead, administrative and institutional controls to minimize human exposure to the contaminants would be implemented. These controls would include:

- posting of warning signs
- establishment of institutional controls
- continuation of public awareness programs
- environmental monitoring
- site reviews conducted every five years

Warning signs in both English and Portuguese would be placed, where not already present, at appropriate intervals along the shoreline of the lower harbor and bay warning the public that swimming and harvesting of shellfish and finfish are prohibited in this area.

Institutional controls would be used to limit the potential for human exposure to site contaminants by restricting or limiting future site use. Currently, there is a ban on consumption of shellfish and finfish from the estuary and lower harbor and bay. This ban would remain in effect until the hazards associated with ingestion of contaminated seafood have been reduced to a satisfactory level. Environmental monitoring would be conducted on a periodic basis.

The prolonged use of institutional controls may also adversely impact future waterfront development. Management of future use of the harbor would be required to reduce the potential for direct contact hazards, and minimize resuspension and migration of contaminated sediments during harbor maintenance activities. This would involve proper planning and management of future dredging activities and recreational uses. Dredging activities that could resuspend contaminated sediments would also have to be assessed for potential risks associated with redistribution of contaminants. Currently, maintenance dredging is restricted in the harbor due to the environmental and human health impacts. These institutional controls would be imposed by federal, state, and municipal governments. The actual means of implementation and duration of restrictions would be decided by the regulatory agencies at that time.

Public awareness programs would be implemented to educate the public on the potential health hazards associated with the lower harbor and bay area sediment. The programs would include periodic meetings and presentations in local neighborhoods, and bilingual pamphlets. These programs would be coordinated with appropriate local and state programs to address PCB contamination in New Bedford Harbor and its potential impact on public health.

Monitoring. A quarterly monitoring program would be implemented to assess long-term trends in sediment and water column PCB concentrations and associated responses in aquatic biota. This program would entail collecting 25 sediment, water, and biota samples from the estuary and 25 sediment, water, and biota samples from the lower harbor and bay four times per year and analyzing these samples for PCBs and metals. For remedial actions which leave contaminated sediment on site, CERCLA legislation requires that the site be reviewed every five years. Data collected as part of the environmental monitoring program would be evaluated during the five-year reviews. Recommendations for potential remedial actions would be formulated, as needed, based on the review.

SW-7 Schedule. Once remedial design activities have been completed and land acquisitions or site access rights have been obtained, this alternative is anticipated to take approximately six years to complete. Construction of the CDF would require about one year. During that time the water treatment facility would be set up. Dredging, which would commence at the completion of CDF construction, is expected to take two years. During the dredging period the hydraulic control structure for capping installation could be constructed, as well as the slurry pond(s) and staging area. Capping of the remaining estuary area is anticipated to take approximately three years. During this time the CDF would be covered and seeded.

2.2.2 Short Term Effectiveness

Minimal risk is anticipated to both workers and the surrounding community during remediation. The dredged sediment disposal area is located in a commercial/industrial zone of New Bedford. Use of fencing and on-site security personnel would preclude unauthorized entry to the area and would be effective in preventing the community from coming into direct contact with the contaminated sediment. Dredging is not expected to generate substantial levels of airborne or volatilized contaminants to which workers in adjacent areas would be exposed (Ebasco, 1990). An air monitoring program would be implemented during dredging and disposal operations. Control measures would be used to reduce emissions to protect worker safety and public health.

Workers on-site during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborne particulates or volatilized contaminants as a result of dredging and disposal operations (e.g., clearing debris from or unclogging the dredgehead, sediment discharge into the CDF).

Dredging is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed along with the sediment and destroyed during the dredging operation. Although it is expected that this area would re-establish itself, this process could be enhanced through a recolonization program. Results of the USACE pilot dredging study indicate that resuspension of contaminated sediment would be minimal when proper dredge operating conditions are used. Average resuspension rates for the cutterhead dredge were 12 g/sec at the dredgehead with suspended solids levels in the water column returning to background within 400 feet of the operating dredge (USACE-NED, 1990). Transport of dredged sediment to the disposal facility via the hydraulic pipeline is not expected to affect the environment. However, the pipeline would be designed to prevent leakage and would be monitored continously.

Although USACE predicts that the capping component of this alternative is anticipated to release less contamination than the dredging operation, accurately quantifying the difference would be difficult (USACE-NED, 1990). The use of geotextile should minimize resuspension of sediment during placement of the sand capping material.

Risk to workers during capping is also anticipated to be low. The only opportunity for contact of contaminated sediment is during geotextile anchoring. Workers involved in anchoring activities would be protected with the appropriate health and safety equipment and clothing.

2.2.3 Long-term Effectiveness and Permanence

Removal and disposal in CDFs of the 112,000 cy of sediment in the upper estuary contaminated with PCBs >500 ppm and capping of the remaining estuary sediments to 50 ppm would remove or isolate a substantial mass of PCBs from the New Bedford Harbor system. This remedial action is expected to reduce the flux of PCBs under the Coggeshall Street Bridge into the lower harbor. Direct comparisons of the reductions in PCB flux and water column PCB concentrations between no action, a 10 ppm TCL, and a 50 ppm TCL in the estuary cannot be made since a TEMPEST/FLESCOT model run was not conducted for the 50 ppm cleanup scenario in the upper estuary only. However, the general trends observed for a 10 ppm TCL would also be expected for a 50 ppm TCL. A 10 ppm TCL cleanup of the estuary resulted in a PCB water column PCB concentration of 25 ng/L by Year 10. Water column PCB concentrations for a 50 ppm TCL are expected to be higher but, like the 10 ppm TCL, would be a significant improvement over the no action scenario in which water column PCB concentrations would be reduced to 850 ng/L by Year 10 (Battelle, 1990).

Remediation of the estuary to 50 ppm would also result in significant and consistent reduction of PCB flux and water column PCB concentrations in the lower harbor compared to the no-action scenario. These improvements would be reflected in the biota which would show reductions in PCB concentrations similar to the reductions projected for a 10 ppm TCL. Residual PCB concentrations in lobster and flounder would not be expected to fall below the 2 ppm FDA tolerance level in all areas. Reductions in biota MATCs would also be expected as a result of a 50 ppm TCL. Projected responses in biota inhabiting the outer harbor would be essentially the same as those discussed in Subsection 7.2.3 of Volume II.

Reduction in shoreline sediment PCB concentrations to 50 ppm would provide an adequate level of protection to human health. A 50-ppm PCB residual concentration was established as the TCL for the estuary and lower harbor/bay and is considered protective of older children and adults from PCB exposure. The corresponding risk level for the 50 ppm PCB TCL is $1x10^{-5}$. Because young children are considered the most sensitive population, risks associated with exposure to 50 ppm PCBs are higher than for older children (ages 6-16 years) and adults (ages 17-65 years). The residual risk for a young child (ages 0-5 years) for a 50 ppm PCB TCL is $5x10^{-5}$, the residual risk for a 10 ppm PCB TCL is approximately $1x10^{-5}$.

USACE considers a total cap thickness of approximately 3 feet to be effective in terms of containing contaminants (Averett, Palermo, Otis, and Rubinoff, 1989). Studies conducted by USACE-WES concluded that a minimum thickness of 35 cm (1.2 feet) was required to provide chemical isolation (i.e., would not allow PCBs to migrate through) (Sturgis and Gunnison, 1988). Furthermore, a 20-cm (0.7 feet) bioturbation barrier was recommended to prevent benthic organisms from burrowing into the chemical barrier. This layer should also prevent root systems from acting as preferential pathways for contaminant migration. Because hydraulic placement of the sand capping material is an inexact construction procedure and uniform placement of the 55 cm chemical seal and biological barrier is difficult to achieve, an additional 30 cm lift (1 foot) is considered a reasonable buffer to ensure that the minimum cap thickness of 55 cm is obtained (Otis, 1990).

An extensive monitoring program would be implemented to ensure that cap integrity is maintained. This program would include hydrographic surveys and sediment cores to provide this function. Institutional controls would likely be required to prevent clamming, small boat traffic, or other activities from damaging the integrity of the cap.

It is anticipated that scouring of the cap may occur over time due to currents, tidal action, or other erosional forces. Therefore, a maintenance program would be designed to ensure cap integrity. This program should anticipate the replacement of approximately 10 percent of the total cap material every five years. Hydrographic surveys would be used to identify those areas requiring this additional material.

Capping would have a limited impact on the estuary, with little of it being changed into intertidal area. Since much of the area to be capped is located within the estuary channel, only approximately 2000 feet of the eastern and western shoreline would be transformed, assuming a 34-inch cap was placed and settles 6 inches (Otis, 1990). Because the sand cap would meet the existing shoreline between the low and high water lines, no upland areas would be created. The capping component of this alternative does not cover any vegetated wetland areas along the eastern shoreline. Most of this wetland is above +3 feet MLW and is only flooded at high tide (Otis, 1990). Flood storage capacity should not be significantly affected because most of the cap would be placed below 4 feet MLW. This elevation is exceeded only in the fringe areas where the cap is tied into the shoreline (Otis, 1990).

If the cap fails, the risks associated with potential exposure would be the same as those estimated under baseline conditions. These risks were estimated to be in excess of state requirements ($1x10^{-5}$) and, depending upon the location, may fall within or exceed the EPA target risk range.

Disposal of sediment containing PCBs and metals in unlined CDFs is not expected to present long-term risks to human health or the environment. The concentration of PCBs and metals in any leachate generated is expected to be minimal. Placement of a cap on the CDF would reduce the potential for leachate generation due to infiltration of precipitation and surface runoff. Furthermore, attenuation of any residual-contaminated leachate would be expected if leachate generated migrates through the earthen dikes of the CDF. Long-term monitoring and maintenance of the CDF cover and monitoring of the CDF dike would be necessary to assess leachate migration and contaminant concentration.

2.2.4 Reduction in Mobility, Toxicity, and Volume

Since this alternative does not employ sediment treatment, no reduction in mobility, toxicity, or volume of contaminants would be achieved through treatment. However, disposal of the contaminated sediment in the CDF is expected to reduce the potential migration of PCBs and metals. Capping is anticipated to provide similar benefits in terms of reduction in contaminant migration.

2.2.5 Implementation

2.2.5.1 Technical Feasibility

Constructability. Dredging is a common operation and has been pilot-tested by USACE in the cove area of the Acushnet River Estuary. Based on results of the pilot test, a cutterhead dredge is recommended, and the operating parameters of this dredge have been established so that sediment resuspension would be minimized. Capping has been performed in numerous deep water locations with effective results. However, installing a cap of this extent in the shallow estuary area would require modification of conventional placement techniques, which have not been demonstrated in this environment.

Shoreline disposal sites are a demonstrated technology currently being used at various locations for the containment of dredge spoils. A small CDF was constructed in the estuary as part of the USACE pilot study to demonstrate site-specific application of this technology.

The water treatment technologies are well-proven for the intended application. Prior to final design, bench-scale studies would be required to determine equipment size, optimum chemical dosage, and activated carbon requirements.

Reliability. Hydraulic dredging with a cutterhead dredge has been demonstrated to be a reliable technology for use in New Bedford Harbor. Delays are likely in the dredging operation due to inclement weather and downtime to remove debris along the shoreline areas.

Capping has been demonstrated as a reliable means of containing contaminants at various deep water locations. However, specific application of this technology within the shallow Acushnet River Estuary of New Bedford Harbor has not been demonstrated to date. Long-term performance of the CDF and the cap cannot be assessed due to the limited amount of monitoring data. Therefore, the possibility exists for leachate to migrate from the CDFs and for contaminants to migrate up through the cap.

Land acquisition for CDF construction may be a problem. Months were required to obtain access to the property for the pilot study. The area identified for staging of the water treatment facility and general operations is located adjacent to the pilot study area.

Schedule delays may be encountered during construction of the CDF embankments if the underlying soils do not consolidate in a timely manner. Seventy-four days were necessary to sufficiently consolidate the first stage before the second stage was constructed in the pilot study. Wick drains would be used to enhance consolidation. These were used by USACE in the pilot study.

Support and Installation. Close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on the shipping activities. Site preparation and land acquisition would be the most significant support requirements for the development of shoreline disposal sites. Approximately 1 acre of land would be required for staging facilities. Specific areas along the western shoreline within the estuary would require access roadways to aid in deployment of the cap. Easements would be required and the shoreline would require some regrading to provide a suitable staging area for capping activities.

Capping in the estuary would require hydraulic controls to maintain water depths to deploy the work barges required for geotextile and sand placement. A temporary staging area would need to be constructed to produce the sand slurry that would be pumped to the locations of deposition.

Ease of Undertaking Additional Remedial Actions. Additional remedial actions may be required where there is unacceptable sediment resuspension with subsequent dispersion during dredging, unacceptable levels of contaminated leachate escaping from the disposal facility, or delayed times in sediment consolidation within the CDF for closure with associated air volatilization.

Sediment resuspension could distribute the contaminated sediments over an area greater than currently exists, causing cleanup to become more costly and requiring more material to be removed from the site. Results from the USACE pilot study carried out in the estuary indicate that resuspension of contaminated sediment during dredging can be minimized. Suspended solids levels measured adjacent to the operating cutterhead dredge averaged 80 mg/L, and had returned to background conditions (10 mg/L) 400 feet from the dredge. No increases in suspended sediment have been observed at any of the far-field sampling locations (e.g., Coggeshall Street Bridge and the Hurricane Barrier). Sediment in the estuary are similar to those in the pilot study; therefore, minimal resuspension is expected in the estuary.

Contaminants leaching out of the shoreline facility back into the environment may require additional remedial actions. Data are being collected from the pilot study to assess the degree to which this may occur. Samples taken from the wells around the pilot study CDF immediately after the site was filled and nine months later were analyzed for PCBs and metals. The results do not indicate any movement of contaminants from the site. USACE also conducted various leachate tests to estimate the quantity and quality of water that seeps through the CDF dikes at the New Bedford Harbor site after filling has been completed. These tests included batch testing and permeameter testing. Chemical analyses conducted during the tests were used to evaluate desorption isotherms. Results of USACE batch leachate tests showed leachate concentrations increasing with time over the duration of the test. However, under actual conditions in the CDF, this phenomenon would not be expected to continue indefinitely. Concentrations of PCBs from the permeameter tests were much lower than those from the batch tests. The peak total PCB concentrations observed in permeameter leachate were 18 ug/L in anaerobic sediment and 17.5 ug/L in aerobic sediment (Meyers and Brannon, 1988). If results from the pilot study indicate a significant release of leachate from the CDF, use of liners in construction of CDFs may need to be reevaluated. Subsection 5.3.3 of Volume II discusses the advantages and disadvantages of lining the CDFs.

Dike collapse, followed by erosion of the disposed sediment, would be unlikely to occur, even during storm events. The Hurricane Barrier is a good example of a stable embankment at New Bedford Harbor, and the locations identified for the shoreline disposal facilities would be in a less active environment.

2.2.5.2 Administrative Feasibility

Coordination among the lead agency (i.e., USACE or EPA), the City of New Bedford and the Commonwealth of Massachusetts would be important. Coordination would involve active communication, including formal and informal meetings, among the agencies at critical points in the remedial action process. Because all activities would be conducted on-site, no permits are needed for these alternatives.

The remedial activities for this alternative would be confined primarily to the upper estuary. Therefore, disruption of the shipping and fishing industry activities in the lower harbor area is not anticipated.

2.2.5.3 Availability of Services and Materials

All activities and technologies associated with this alternative are general in nature and do not require highly specialized equipment or personnel. Cutterhead dredges for dredging sediment and land-based heavy construction equipment for constructing the CDFs are readily available. Vendors and contractors dealing with marine construction can provide the equipment as well as the health and safety trained personnel to operate this equipment.

2.2.6 Cost

Table 2-2 presents the capital and O&M costs for Alternative SW-7. Land acquisition costs are not included. Separate cost components of this alternative include CDF construction; dredging of sediments with PCB concentrations >500 ppm and disposal into a CDF; water treatment of CDF effluent; and capping of the remaining estuary sediment containing 50 ppm to 500 ppm PCBs. The costs for monitoring presented in Table 2-2 include long-term monitoring in both the estuary and lower harbor/bay areas. Figure 2-4 illustrates the cost breakdown for each of the alternative components. The total estimated cost for Alternative SW-7 is $36.1 million dollars.

The costs for constructing CDF 1 were derived from past CDF construction experience in similar conditions and costs that were incurred for the construction of the pilot study CDF. Included in these costs are material and labor for the dike fill, geotextile and stone protection, covering the CDF with geomembrane, clean topsoil and seeding when remedial activities are completed. Costs

TABLE 2-2

COST ESTIMATE: ALTERNATIVE SW-7
DREDGE/CAP ESTUARY
NEW BEDFORD HARBOR

ACTIVITY	COST
I. DIRECT COSTS	
A. Dredging >500 ppm	$1,082,000
B. Capping >50-<500 ppm	$14,200,000
C. Water Treatment	$2,050,000
D. CDF Construction	$2,771,000
DIRECT COST	$20,103,000
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection [25% of Comp. of Activity B, and C]	$134,000
B. Legal, Administration, Permitting (@ 6%)	$1,206,000
C. Engineering (@ 10%)	$2,010,000
D. Services During Construction (@ 10%)	$2,010,000
E. Turnkey Contractor Fee (@ 15%)	$3,015,000
INDIRECT COST	$8,375,000
SUBTOTAL COST	$28,478,000
CONTINGENCY (@ 20%)	$5,696,000
TOTAL CAPITAL COST	$34,174,000
PRESENT WORTH COST - 1989 (@ 5% for 6 years)	$28,909,000
O&M COST (Cap and CDFs) (present worth @ 5% for 30 years upon completion)	$1,438,000
MONITORING PROGRAM (present worth @ 5% for 30 years)	$5,817,000
TOTAL COST - ALTERNATIVE SW-7	$36,164,000

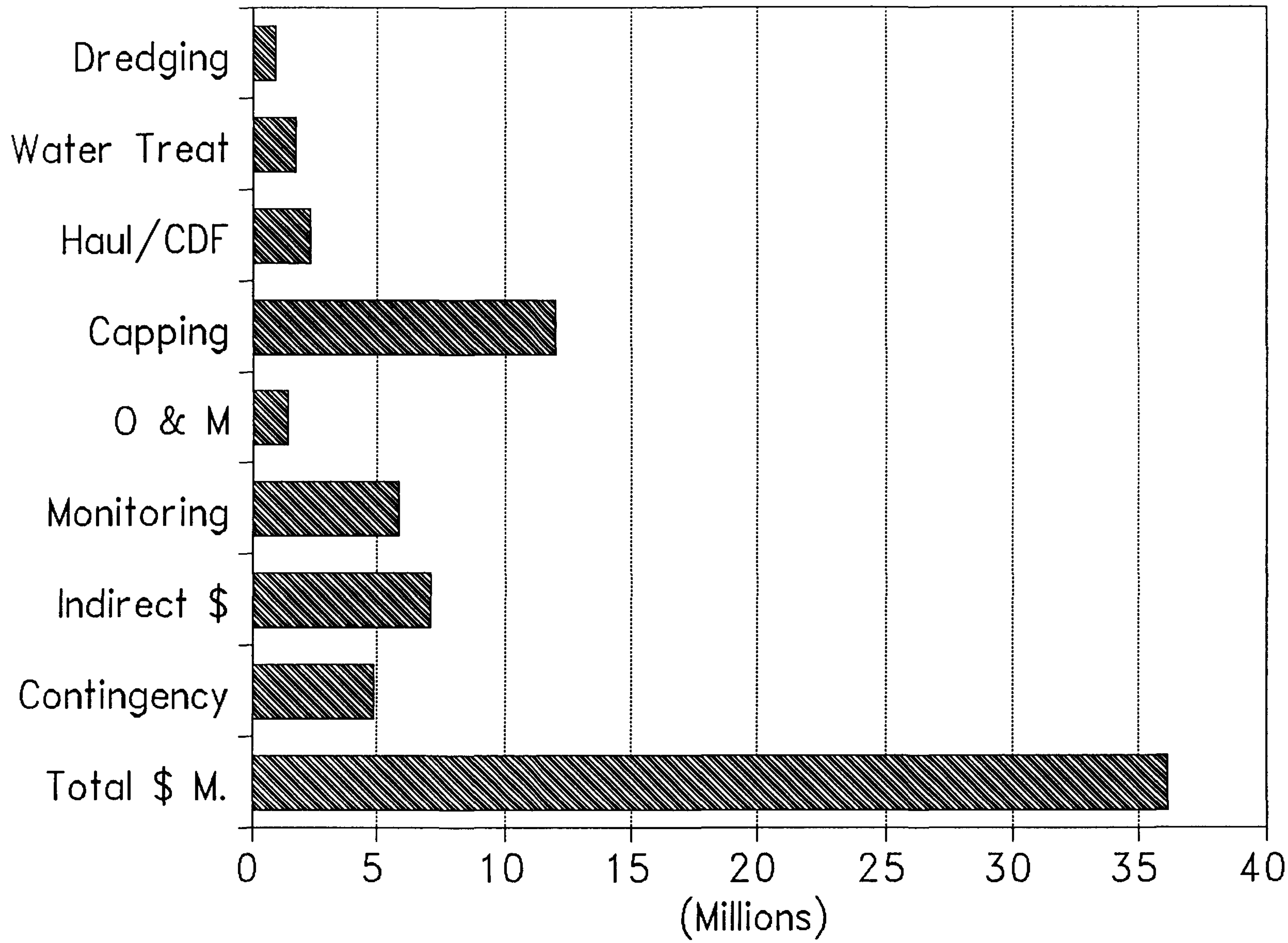


Figure 2-4

Cost Estimate SW-7
Estuary and Lower Harbor and Bay

New Bedford Harbor

also include deployment of silt curtains, fencing, and traffic control during construction. Health and safety factors were included in the various items where required.

The dredging component includes all anticipated costs dealing with removing sediment from the estuary. Items include equipment costs, operating costs, piping and pumping the materials, and mobilization/demobilization and shutdown. The cost analysis also considered hazard protection equipment and monitoring. Other miscellaneous items included in the total cost are overhead, bond, and profit. The total cost was then broken down to $9.66/cy in situ. (Averett, Palermo, Otis and Rubinoff, 1989).

Water treatment costs for this alternative involve treating the effluent prior to discharge back to the estuary. The equipment necessary to perform this function include a water holding tank and screening system, a coagulation/flocculation unit, a reactor/clarifier, and dual-media and carbon adsorption filtration units. The costs also include incineration of the spent carbon, as well as a small building to house this equipment. Costs for the water treatment facility include O&M for the length of time necessary to remediate the given TCL. This facility has been designed to accommodate 1.5 million gallons per day (gpd), although currently only 929,000 gallons are anticipated to be treated daily.

Cost estimates for capping estuary sediment containing 50 ppm to 500 ppm PCBs include construction and removal of a hydraulic control structure, geotextile placement, sand placement, stone placement, and survey and monitoring. Costs for the hydraulic control structure in the estuary include a sheetpile structure located immediately adjacent to the Coggeshall Street Bridge. The structure would be anchored to the eastern and western shorelines and would be constructed using barge-mounted equipment. The structure would have weirs and mechanically operated gates, as well as a walkway across the top.

Geotextile placement costs involve all anticipated costs in preparation and placement of the fabric, including approximately 10 percent overlap. Costs for sand placement include all aspects of this task. Trucking, dredge, and barge deployment costs are included. Costs for the hydrographic surveys and sediment core collection before, during, and after the remedial activities are also included.

Health and safety costs, where not included as part of a line item within a given component (e.g., dredging), were added as other direct costs. For this alternative, costs for Level D health and safety protective equipment were added to the water treatment and material transport components at 5 percent of the overall cost of that item. For most activities, this is considered appropriate because no contact with contaminated material is anticipated.

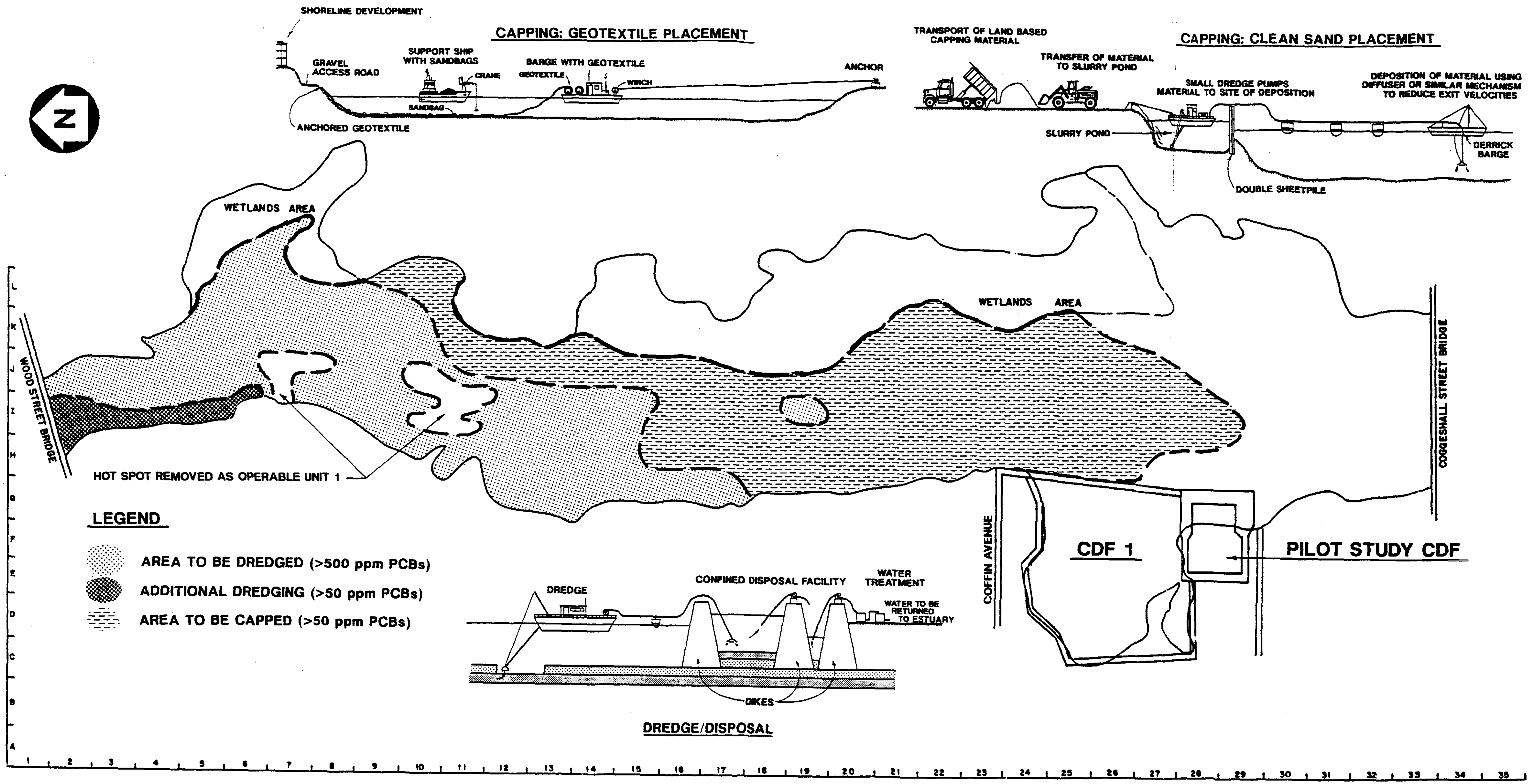


FIGURE 2-2
ALTERNATIVE SW-7: REMEDIAL AREA AND FACILITY SITING
ESTUARY AND LOWER HARBOR AND BAY FEASIBILITY STUDY
NEW BEDFORD HARBOR

However, some specific operations (e.g., clearing debris from dredgehead) would require Level C protection.

Other costs were also considered for the total cost of implementing this alternative. Legal, administrative, and permitting costs are anticipated to add an additional 6 percent of the total capital and O&M costs. Engineering and services during remediation are anticipated to cost an additional 10 percent each. Fees for the prime contractor administering the remediation are an additional 15 percent. Finally, a 20 percent contingency has been added to the subtotal of these items to derive the final cost for this alternative.

2.2.7 Compliance with ARARs

Alternative SW-7, dredging, on-site disposal of contaminated sediments, and capping of in-situ sediments in the upper estuary is designed to meet the 50-ppm PCB TCL for sediments in the estuary only. Chemical-specific ARARs for this alternative are presented in Subsection 4.2.2.1 of Volume I. It is anticipated that Alternative SW-7 would not attain the AWQC for water column PCB concentrations in the estuary and lower harbor areas at the end of ten years. The FDA tolerance level of 2 ppm for biota would not be attained in all areas at the end of ten years.

Massachusetts Surface Water Quality Standards (310 CMR 4.00) would apply to the treatment of the effluent that would be generated when dewatering the dredged sediments in the CDF. This regulation sets standards for maximum levels of contaminants that can be discharged to the surface waters of the state.

National Air Quality Standards (40 CFR 40) and Massachusetts Air Pollution and Air Quality Regulations (310 CMR 6.00-8.00) would apply to this alternative because no remedial action should cause a negative impact on existing air quality. Monitoring systems can be engineered into the implementation of this alternative to gauge whether dredging and disposal of the sediments cause volatilization of any contaminants. Any impacts detected would be prevented or minimized by best available engineering controls during dredging and disposal activities.

Dredging sediment would trigger federal and state location-specific ARARs for wetlands and floodplains. These ARARs are described in Subsection 4.2.2.2. Substantive requirements of Section 404 of the CWA and the USACE regulations at 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

If a functioning wetland with environmental value is negatively affected from a remedial action, mitigation techniques such as wetland restoration, enhancement, or creation may be appropriate. Executive Orders 11988 and 11990 (see Subsection 4.2.2.2), which are implemented through NEPA (40 CFR Part 6, Appendix A), are ARARs that may also require wetlands and floodplain mitigation. If excavation of the wetlands is required, then restoration of wetlands would occur as part of the construction of this alternative. Reclamation of wetlands damaged or destroyed is included as an option to Alternatives EST-3 and LHB-3, and subsequent alternatives that potentially require dredging and excavation of estuary wetlands.

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetlands protection regulations apply. Compliance with substantive requirements would be met.

Several action-specific ARARs would go into effect during various phases of implementation of this alternative. Under the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00), dredging and transport of contaminated sediments to shore-based facilities would have to meet technology requirements set forth in these regulations. Dredging techniques are determined by the characteristics of sediments and material to be dredged. This material would be transported to shore using best engineering practices. The Administration of Waterways Licenses sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These requirements can be met through engineered controls implemented during construction. Dredging activities would be timed and coordinated to minimize interference with shipping and boating traffic, and a monitoring program would be implemented during dredging to detect and minimize the spread of contaminated sediments.

ARARs that pertain to the water treatment component of this alternative relate to either the O&M of wastewater treatment facilities (314 CMR 12.00) or treatment standards for process waters. Pilot test results indicate that treatment of the supernatant water generated during dewatering would meet promulgated treatment standards. Construction and operation procedures and standards would be attained through inclusion in the design and implementation of the alternative.

TSCA regulations (40 CFR 761) regulate the disposal of dredged materials contaminated with PCBs in concentrations of 50 ppm or more. This material must be incinerated to meet the performance requirements of 40 CFR 761.70, or placed in a chemical waste landfill in compliance with the technical requirements of 40 CFR 761.75. Alternative remedial actions may be approved by EPA if technical, environmental, and economic considerations indicate disposal in a federally permitted incinerator or chemical waste landfill is not reasonable or appropriate. Alternative disposal methods must provide adequate protection to human health and the environment.

Due to the heavy metal contamination, the dredged sediment may be considered a characteristic hazardous waste. Since these alternatives constitute "excavation/placement," RCRA Land Ban regulations (40 CFR 264.300-264.339) may apply.

Massachusetts Hazardous Waste Regulations (310 CMR 30.00) are relevant and appropriate to the design, construction, and O&M of the CDFs. In general, federal RCRA regulations govern these remedial activities. However, under CERCLA, more stringent state requirements (eg., 310 CMR 30.620-Landfills) supersede federal standards. To comply with 310 CMR 30.00, the CDFs would need to achieve a minimum permeability standard of $1x10^{-7}$ cm/sec. This alternative does not include a liner as part of CDF construction. Therefore, a waiver of this ARAR may be required.

Massachusetts Hazardous Waste Regulations also govern the closure and post-closure care of the CDFs. Closure requirements (310 CMR 30.580) state that a final cover must be designed and constructed to prevent migration of liquids, have minimal maintenance requirements, promote drainage, minimize erosion, and accommodate settling. The cover integrity should be maintained throughout the post-closure care period. The proposed containment system would meet these requirements to the extent applicable and would be periodically monitored to assure its effectiveness.

Construction and placement of the cap will trigger several federal and state location-specific ARARs for floodplains and wetlands. Section 404 of the CWA regulates the deposit of dredged or fill material into waters of the U.S. Capping activities are regulated under Section 404. USACE has responsibility for administering the Section 404 permitting process. Pursuant to Section 212(e) of SARA, permit requirements under Section 404 are waived for activities occurring on-site; however, compliance with the substantive standards must be achieved.

In addition to the USACE administration of Section 404 of the CWA, the Massachusetts Wetlands Protection Act and regulations under 310

CMR 10.00 apply to all activities occurring in wetlands or in the 100-foot buffer zone. Similar to the federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is waived for all on-site activities. However, the local commission should be apprised of proposed activities and given the opportunity to review the draft New Bedford Harbor reports. Compliance with all substantive requirements of 310 CMR 10.00 and with the Massachusetts Water Quality Certification requirements at 314 CMR 9.00 is also required for activities involving dredging in wetlands or waterways.

Placement of the cap would require compliance with the procedural requirements outlined in the Administration of Waterway Licenses (310 CMR 9.00). These procedures were promulgated for the protection of tidal, wetland, estuarine, and marine resources, as well as public rights of navigation. Procedures relevant to the implementation of the capping alternative are those concerning construction activities in high tide areas and lands in designated port areas.

Capping will only reduce the accessibility to and migration potential of hazardous contaminants in the sediments. Therefore, the statutory preference for remedial actions in which treatment significantly reduces the mobility, toxicity, or volume of hazardous substances would not be achieved.

RCRA landfill closure regulations at 40 CFR 264.310 are appropriate to the design and care of the cap. RCRA closure requirements state that final cover be designed and constructed to accommodate settling, and the cover integrity should be maintained throughout the post-closure care period. The proposed containment system meets these requirements to the extent applicable and would be periodically monitored to assure its effectiveness.

All site activities, including monitoring, would be carried out pursuant to OSHA standards (i.e., 29 CFR 1904, 1910, and 1926) and Massachusetts Right-to-Know regulations (see Subsection 4.2.2.3).

2.2.8 Overall Protection of Public Health and the Environment

Containment of contaminated sediment in the estuary by capping and disposal in shoreline CDFs would effectively reduce the potential for direct contact exposure and limit the source of PCB contamination in surface water and biota. Reduction of shoreline sediment PCB concentrations to 50 ppm would provide an adequate level of protection to human health and a significant reduction in ecological risks over baseline conditions. The 50-ppm TCL protects older children and adults from the dangers associated with direct contact exposure to sediments. Because young children are considered the most sensitive population, the residual risks associated with a 50 ppm TCL are higher than for older children and adults and are estimated to be $5x10^{-5}$. The residual risks associated with a 50 ppm PCB cleanup level are within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Surface water and biota concentrations are expected to decrease as a result of containment actions. However, because this alternative does not reduce the toxicity or volume of contaminated sediment, potential exists for significant risks to human health and environmental biota if the cap or CDF fails. Human health risks, similar to those estimated under baseline conditions, could result if shoreline sediments become exposed in the future. Potential ecological risks would also result from a failure of the containment system. However, these risks would be depend on the location and magnitude of any failure experienced.

Residual PCB concentrations in lobster and flounder would not be expected to fall below the 2 ppm FDA tolerance level in all areas. However, it is expected that significant reductions in the MATCs for aquatic biota such as marine fish, mollusks, crustaceans, and algae would be achieved for a 50 ppm TCL at the end of ten years following remediation.

Short-term ecological impacts are expected. Benthic biota residing in the contaminated sediment would be destroyed during sediment dredging and cap installation. The time required to fully recolonize the impacted area is not known.

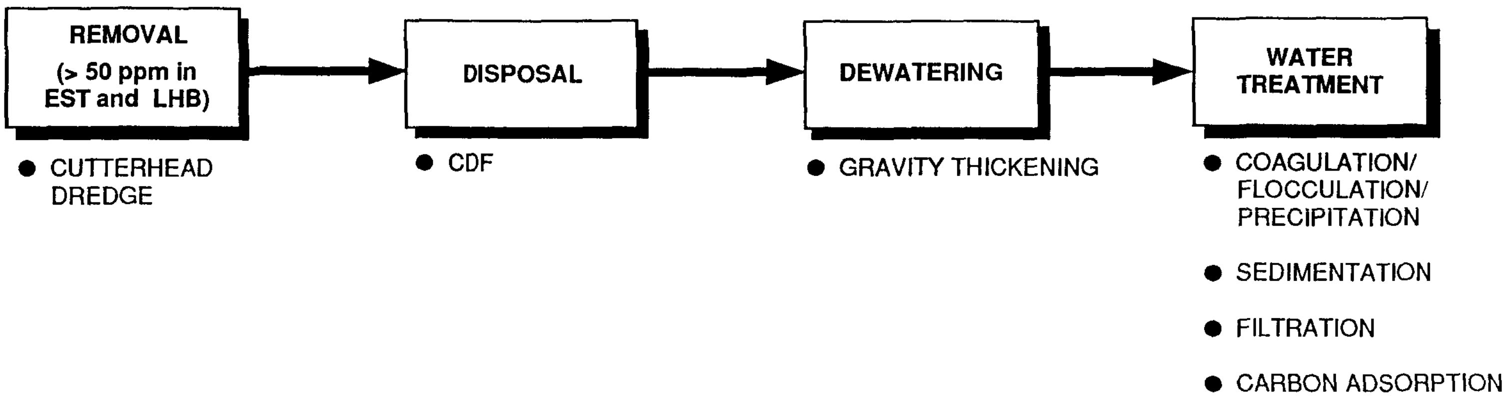
2.3 DESCRIPTION AND ANALYSIS OF ALTERNATIVE SW-8

2.3.1 General Description

Alternative SW-8 entails dredging contaminated sediment greater than 50 ppm PCBs in both the estuary and the lower harbor and bay, and disposing of them in shoreline CDFs. Figure 2-5 presents a block diagram of the components for Alternative SW-8.

CDF Construction. Due to the volume of dredged sediment and sediment bulking during handling, three CDFs would be constructed to contain the dredged material for this alternative: CDFs 1, 1a and 3. CDF 1 would be constructed approximately 2000 feet north of the Coggeshall Street Bridge in the cove on the western shore. CDF 1a would be constructed to the south and immediately adjacent to CDF 1 along the western shoreline of the estuary. CDF 3 will be constructed in a small cove approximately 1500 feet north of the Coggeshall Street Bridge on the eastern shore. The locations of these CDFs are identified in Figure 2-6. Subsection 5.3.3 of Volume II describes CDF construction in greater detail.

Dredging. After construction of CDF 1, dredging of the contaminated sediment in the estuary could commence while CDFs 1a and 3 are constructed. Approximately 118 acres of the estuary contain sediment with PCBs >50 ppm. Two cutterhead dredges making



KEY

EST = UPPER ESTUARY
LHB = LOWER HARBOR AND BAY

FIGURE 2-5
ALTERNATIVE SW-8
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

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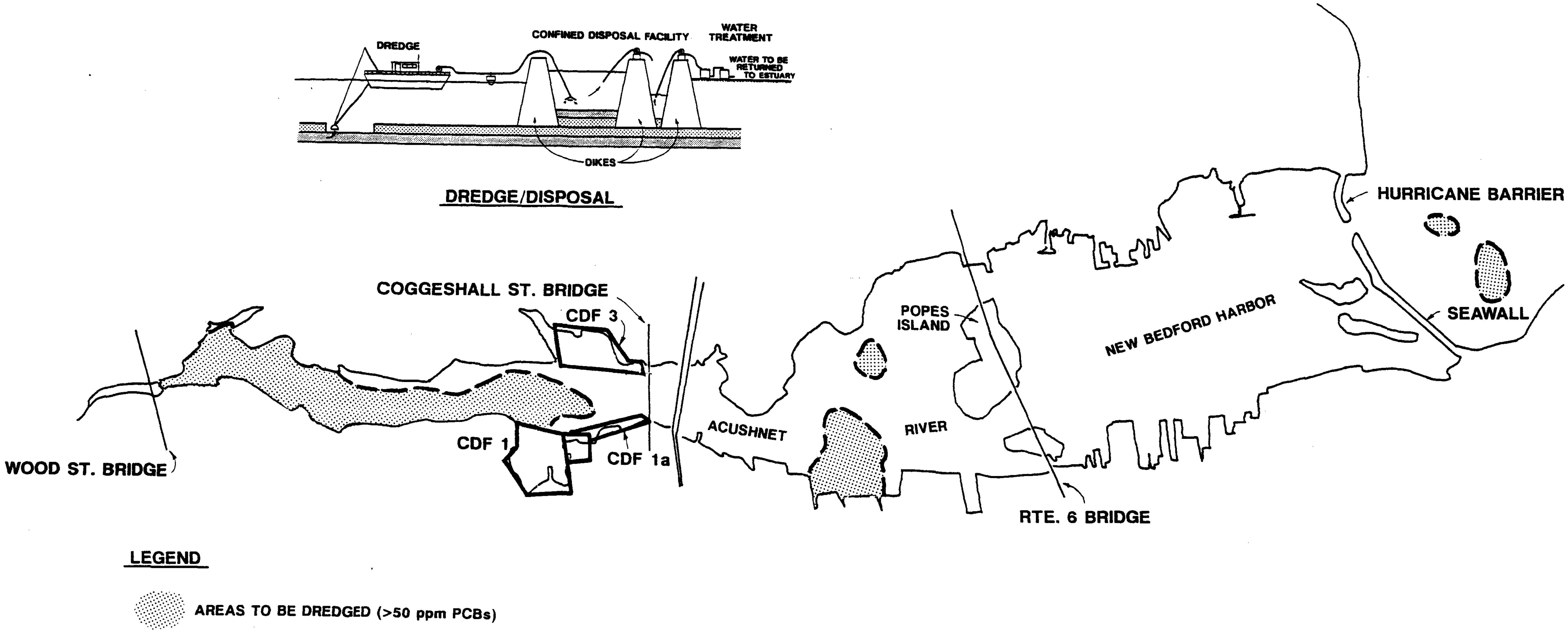


NOT TO SCALE

FIGURE 2-6
ALTERNATIVE SW-8: REMEDIAL AREAS AND FACILITY SITING
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

two passes to a total depth of one and a half feet in this area would remove a total volume of approximately 232,000 cy of sediment. Since CDF 1 is located within the 50 ppm sediment boundary, dredging under the footprint of this CDF is not necessary, thereby eliminating the need to dredge approximately 52,000 cy of sediment.

Dredging in the lower harbor and bay would commence once dredging operations in the estuary have been completed. Approximately 47 acres in four separate areas would be dredged to remove a total volume of 76,000 cy of sediment containing PCBs >50 ppm. Two areas are located in the northern part of the harbor between the Route 6 Bridge and the Route I-195 Bridge. Two smaller areas are located immediately outside the Hurricane Barrier near the western shore (see Figure 2-6). The sediment dredged in the northern part of the harbor would be hydraulically pumped to the disposal facility located adjacent to CDF 1 in the estuary.

The sediment dredged from outside the Hurricane Barrier would be collected in barges and transported up the harbor to the Route I-195 Bridge area. The dredged sediment would be hydraulically unloaded and pumped to the CDFs. Each barge is capable of carrying approximately 500 cy of material. Therefore, four barges would be needed to maintain the dredge output.

<u>Dewatering/Water Treatment.</u> Sediment dewatering and treatment of the CDF effluent will be conducted as described in Subsection 2.2.1.

<u>Disposal.</u> Disposal of dredged sediment and CDF closure will be conducted as described in Subsection 2.2.1.

<u>Monitoring.</u> A long-term monitoring program will be implemented as discussed for Alternative SW-7 (Subsection 2.2.1).

<u>SW-8 Schedule.</u> Once remedial design activities have been completed and all land acquisition or site access rights have been obtained, this alternative is anticipated to take six years to complete. Construction of CDF 1 would take approximately one year. During that time the water treatment facilities would also be set up. Once these facilities are in place, dredging could commence. Dredging the contaminated sediments in >50 ppm PCBs would take approximately five years. Due to the composition of sediments and deeper waters in the lower harbor and bay, this timeframe may be conservative. These sandy sediments in the harbor are not expected to resuspend at the same rate as the fine grain material from the estuary. Therefore, dredging may occur at a faster rate. In addition, the dredging would not be influenced by tides as in the estuary, thereby extending the daily period of operation. Sediment discharged to the CDF will be allowed to consolidate before the CDFs are capped and seeded.

2.3.2 Short-term Effectiveness

Minimal risk is anticipated to both workers and the surrounding community during implementation of this alternative for the reasons discussed in Subsection 2.2.2. Appropriate monitoring of airborne or volatilized contaminants would be conducted during all dredging and disposal operations and control measures would be implemented. Workers on-site during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborne particulates or volatilized contaminants as a result of dredging and disposal operations (e.g. clearing debris from or unclogging the dredgehead).

Dredging is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed and destroyed during the dredging operation. Although it is expected that this area would rapidly reestablish itself, this process could be enhanced through a recolonization program.

Transport of dredged sediment to the disposal facility via the hydraulic pipeline is not expected to affect the environment; however, the pipeline would be designed to prevent and be continously monitored for leakage.

2.3.3 Long-term Effectiveness and Permanence

Removal of 308,000 cy of contaminated sediment from the upper estuary and the lower harbor and bay to achieve a site-wide 50-ppm sediment TCL would remove a substantial mass of PCBs. At Year Zero (immediately following remediation) bed sediment PCB mass in the upper estuary would be reduced dramatically compared to the minimal no-action scenario. A less dramatic reduction in PCB mass would be achieved in the lower harbor compared with the minimal no-action scenario.

Results of the TEMPEST/FLESCOTT model run for the 50 ppm site-wide TCL project a similar pattern of PCB flux through the Coggeshall Street Bridge as projected for the 10 ppm TCL estuary and lower harbor scenario. TEMPEST/FLESCOTT projections over the a ten-year period for PCB flux into the upper estuary are essentially the same for the 10 ppm and 50 ppm site-wide scenarios. This flux of PCBs is in the reverse direction from the no-action scenario (Battelle, 1990). This reversal means that PCBs from the contaminated sediment remaining in the lower harbor are migrating up the estuary and being transferred to the relatively cleaner sediments there. At Year Zero, the model estimates that approximately 20 kg/yr PCBs would be transported into the upper estuary. By Year 10, the PCB flux would be reduced to less than 1.0 kg/yr. However, in the case of the 50 ppm TCL, the net flux of PCBs at Year 10 would be out of the upper estuary.

An obvious benefit of this remedial action would be significant reduction in the water column PCB concentrations in the upper estuary and the lower harbor and bay. TEMPEST/FLESCOTT projections for a site-wide 50 ppm TCL show average water column PCB concentrations would be reduced to 40 ng/L, 91 ng/L, and 31 ng/L in Year Zero in the upper estuary, lower harbor, and upper bay, respectively. Figure 2-7 shows a continual decline in water column PCB concentrations in these areas over a ten-year period. By Year 10, water column PCB concentrations have declined to 28 ng/L, 28 ng/L, and 11 ng/L in the upper estuary, lower harbor, and upper bay, respectively. This represents a significant improvement over the no-action scenario for the upper estuary and lower harbor in which water column PCB concentrations of 1,634 ng/L and 167 ng/L at Year Zero would be reduced to 850 ng/L and 99 ng/L by Year 10 (Battelle, 1990) in the upper estuary and lower harbor areas, respectively. No demonstrable difference is observed for water column PCB concentrations in the upper bay between no action and a 50 ppm TCL.

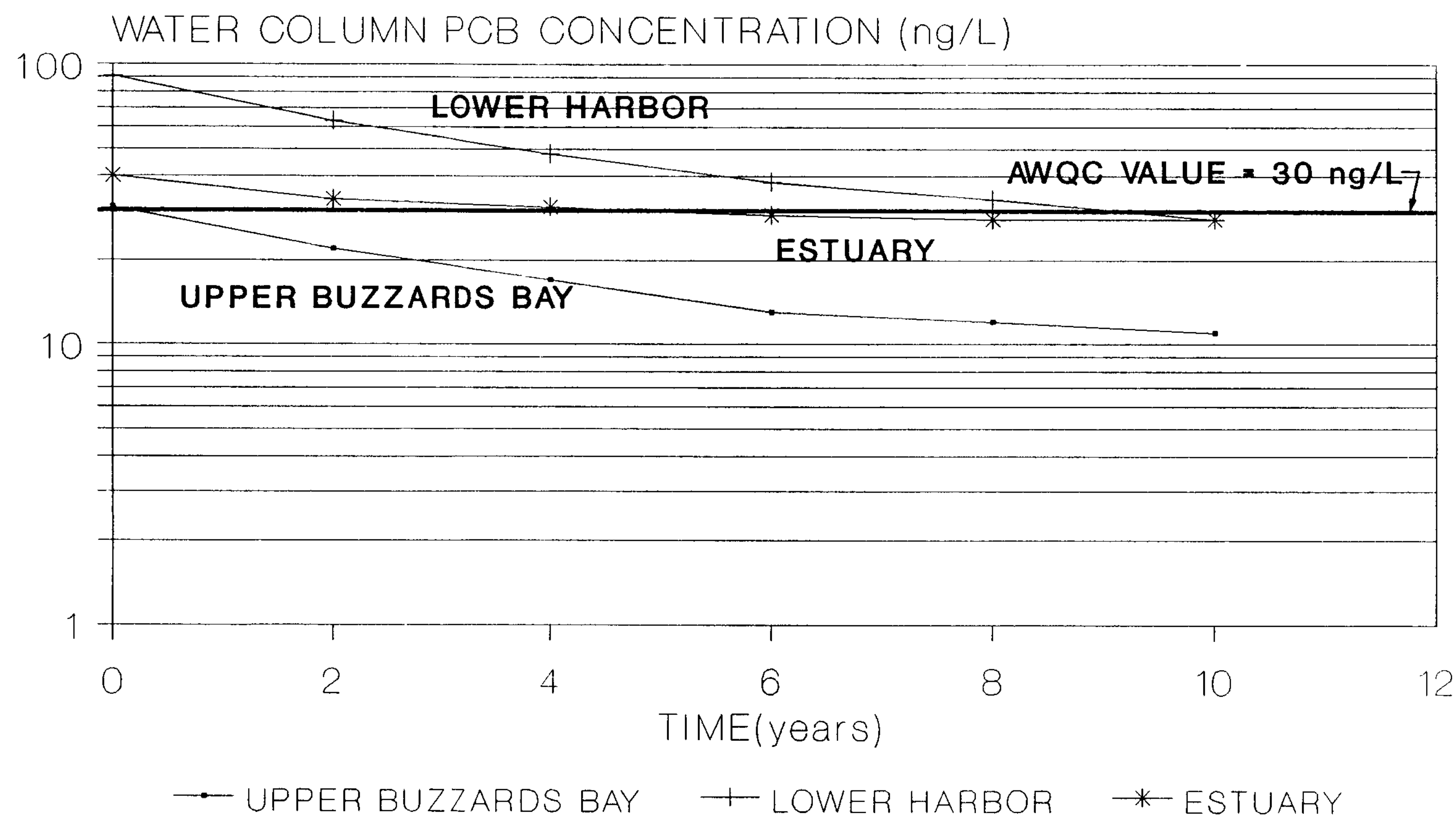
Results of the 10 ppm and the 50 ppm TEMPEST/FLESCOTT projections for water column PCB concentrations in the upper estuary, lower harbor and bay are essentially equivalent. Water column PCB concentrations in all three areas follow the same pattern throughout the ten year modeling period. At Year 10, water column PCB concentrations in the upper estuary, lower harbor, and upper bay are 15 ng/L, 22 ng/L, and 10 ng/L, respectively, for a 10 ppm TCL, and 28 ng/L, 28 ng/L, and 11 ng/L, respectively, for a 50 ppm TCL (Figure 2-8).

Projected improvements on water column and sediment PCB concentrations in the estuary and lower harbor would be reflected in the biota. Remediation to a 50 ppm TCL is estimated to result in similar reductions in flounder PCB concentrations as was estimated for the 10 ppm TCL (Battelle, 1990). Projected biota responses in the outer harbor would be essentially the same as for no action.

Table 2-3 presents the computed concentrations of the lower food chain biota for Year 10 after remediation to a 50 ppm TCL. The residual PCB concentration in the hard clam, mussel, and crab fall below the FDA tolerance level by Year 10. However, these concentrations remain in excess of the site-specific health-based 0.02 ppm RTL which was developed in Section 4.0. Similar results were obtained for a 10 ppm TCL. The hard clam, mussel, and crab from New Bedford Harbor are species that may be consumed on a regular basis.

Based on an average water column PCB concentration of 28 ng/L in both the upper estuary and the lower harbor at the end of the 10-

MODELED WATER COLUMN PCB CONCENTRATIONS FOLLOWING CLEANUP OF ESTUARY AND LOWER HARBOR TO 50 ppm

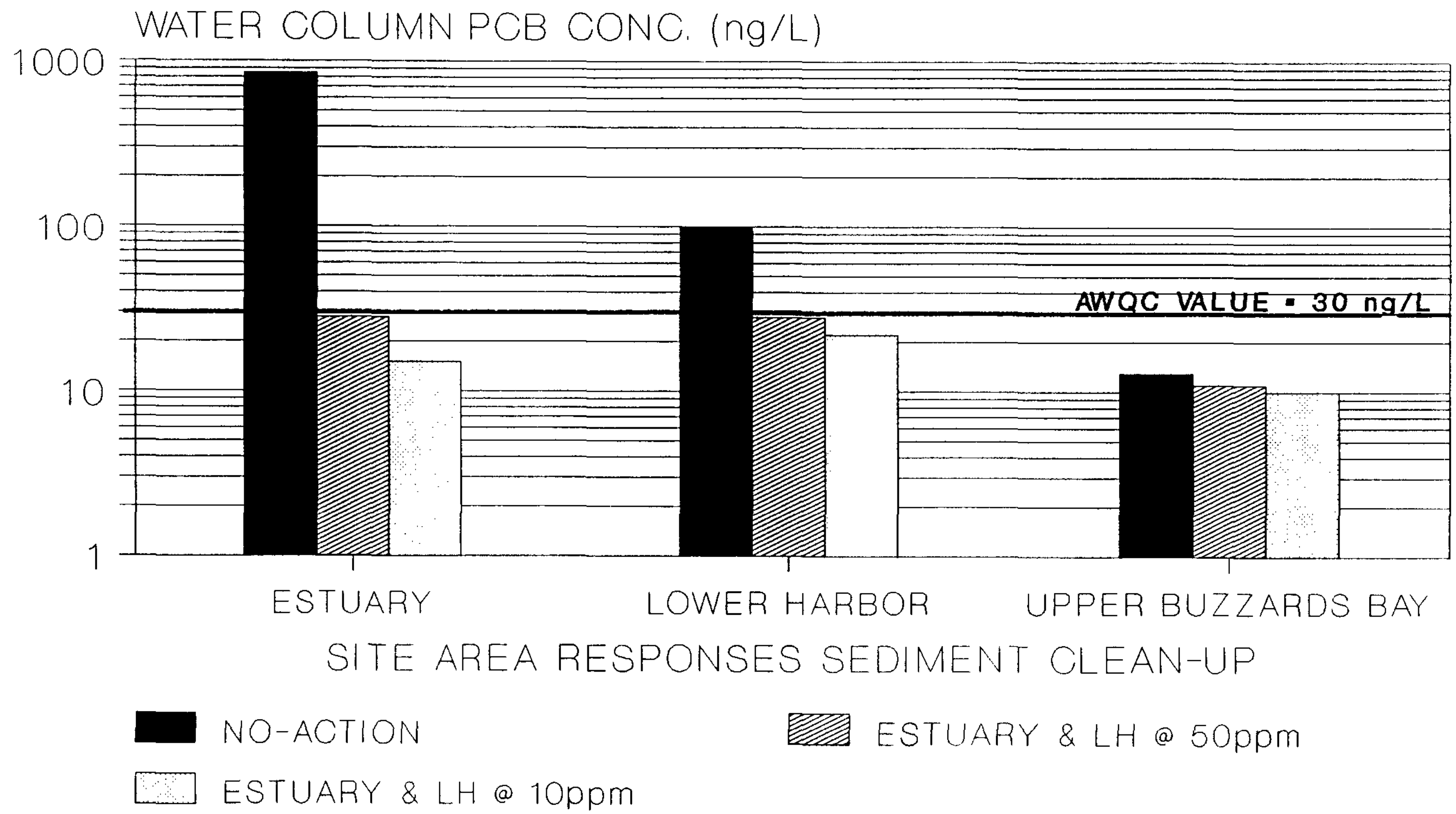


MODEL PROJECTIONS FOR 10
YEARS FOLLOWING CLEANUP

FIGURE 2-7

NEW BEDFORD HARBOR
FEASIBILITY STUDY

SUMMARY OF MODELED WATER COLUMN PCB CONCENTRATIONS IN RESPONSE TO 10 ppm AND 50 ppm SEDIMENT CLEANUP



MODEL PROJECTIONS FOR YEAR 10 FOLLOWING SEDIMENT CLEANUP TO 10 ppm AND 50 ppm

FIGURE 2-8

NEW BEDFORD HARBOR FEASIBILITY STUDY

TABLE 2-3

COMPUTED PCB CONCENTRATIONS IN LOWER FOOD CHAIN BIOTA (ug/g WET WEIGHT) FROM NEW BEDFORD HARBOR TEN YEARS AFTER REMEDIATION OF UPPER ESTUARY AND LOWER HARBOR TO 50 PPM

SPECIES	UPPER ESTUARY	POPES ISLAND TO COGGESHALL	AREAS MODELED BY WASTOX AREA 1	AREA 2	AREA 3
Phytoplankton	0.7	1.0	0.7	0.3	NC
Polychaete	5.5	5.6	4.0	1.5	NC
Hard Clam	0.3	0.4	0.3	0.1	NC
Mussel	0.7	1.0	0.8	0.3	NC
Crab	1.1	1.4	1.0	0.4	NC

NOTES:

1. Estimated values for upper estuary and Popes Island to Coggeshall Street Bridge Region at steady-state with projected Year 10 water column and sediment PCB concentrations.

2. Values for Areas 1-3 are from the results of the food chain model which was calibrated for these areas (Figure 2-14).

3. NC - Not Computed

year simulation, the MATCs would be exceeded for approximately 20 percent of the marine fish, less than 5 percent of the mollusks, and 10 percent of the algae. MATCs would not be exceeded for the crustaceans. These numbers can be compared with the MATCs for the minimal no-action scenario of approximately 70, 20, 35, and 22 percent for the marine fish, mollusks, algae and crustaceans, respectively.

Reduction in shoreline sediment PCB concentrations to 50 ppm would provide an adequate level of protection to human health. A 50-ppm PCB residual concentration for the estuary and lower harbor/bay is protective for older children (ages 6 to 16 years) and adults (ages 17 to 65 years) from direct contact to PCBs. Because young children are considered the most sensitive population, the residual risks associated with exposure to 50 ppm PCB are greater than for older children and adults and are estimated to be $5x10^{-5}$. By comparison, the residual risks for young children (ages 0 to 5 years) associated with exposure to 10 ppm PCBs is $1x10^{-5}$. Both risk estimates fall within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Disposal of sediment containing PCBs and metals in unlined CDFs is not expected to present long-term risks to human health or the environment. The concentration of PCBs and metals in any leachate generated is expected to be minimal. Placement of a cap on the CDF would reduce the potential for leachate generation due to infiltration of precipitation and surface runoff. Furthermore, attenuation of any residual-contaminated leachate would be expected if leachate generated migrates through the earthen dikes of the CDF. Long-term monitoring and maintenance of the CDF cover and monitoring of the CDF dike would be necessary to assess leachate migration and contaminant concentration.

2.3.4 Reduction in Mobility, Toxicity, and Volume

Since no sediment treatment is employed in this alternative, there would be no reduction in the mobility, toxicity, or volume associated with treatment. However, dredging and disposal of contaminated sediment in shoreline CDFs is expected to reduce the migration potential of PCBs and metals.

2.3.5 Implementation

2.3.5.1 Technical Feasiblity

Constructability. The constructability of this alternative is similar to the dredge and disposal portion of Alternative SW-7 (see Subsection 2.2.5.1).

Reliability. The reliability of this alternative is similar to Alternative SW-7 (see Subsection 2.2.5.1).

Support and Installation. Close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on commercial shipping and fishing activities in the lower harbor. Tugs, tow vessels, and trucks would be required to move the cutterhead dredge to designated areas. Construction of the hydraulic pipelines would require floating pipes and support crews and vessels.

Site preparation and land acquisition would be the most significant support requirements for the development of shoreline disposal sites. Access to the facilities would also need to be secured. Land acquisition and site preparation would also be required for construction of the staging and water treatment facility. Approximately 1 acre of land would be required for the facility, plus access for the support personnel.

Ease of Undertaking Additional Remedial Actions. Additional remedial actions which may be required for this alternative are similar to those discussed for Alternative SW-7 (see Subsection 2.2.5.1).

2.3.5.2 Administrative Feasibility

Coordination among the lead agency (i.e., USACE or EPA), the City of New Bedford and the Commonwealth of Massachusetts would be important. Coordination would involve active communication, including formal and informal meetings, among the agencies at critical points in the remedial action process. Because all activities would be conducted on-site, no permits are needed for these alternatives.

Since this alternative would include remedial activities in the lower harbor area, coordination would also be required between the lead agencies and the Harbor Master to assure minimal interference with the commercial shipping and fishing industries.

2.3.5.3 Availability of Services and Materials

All activities and technologies associated with this alternative are general in nature and do not require highly specialized equipment or personnel. Cutterhead dredges for dredging sediment and land-based heavy construction equipment for constructing the CDFs are readily available. Vendors and contractors dealing with marine construction can provide the equipment as well as the health and safety trained personnel to operate this equipment.

2.3.6 Cost

Table 2-4 presents the capital and O&M costs for Alternative SW-8. Land acquisition costs are not included. Separate cost components

TABLE 2-4

COST ESTIMATE: ALTERNATIVE SW-8
DREDGE >50ppm/DISPOSE
NEW BEDFORD HARBOR

ACTIVITY	COST
I. DIRECT COSTS	
A. Dredging	$3,292,000
B. Water Treatment	$4,761,000
C. CDF Construction	$10,448,000
DIRECT COST	$18,501,000
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection [Activity: B]	$238,000
B. Legal, Administration, Permitting (@ 6%)	$1,110,000
C. Engineering (@ 10%)	$1,850,000
D. Services During Construction (@ 10%)	$1,850,000
E. Turnkey Contractor Fee (@ 15%)	$2,775,000
INDIRECT COST	$7,823,000
SUBTOTAL COST	$26,324,000
CONTINGENCY (@ 20%)	$5,265,000
TOTAL CAPITAL COST	$31,589,000
PRESENT WORTH COST - 1989 (@ 5% for 6 years)	$26,723,000
O&M COSTS (CDFs) (present worth @ 5% for 30 years upon completion)	$734,000
MONITORING PROGRAM (present worth @ 5% for 30 years)	$5,817,000
TOTAL COST - ALTERNATIVE SW-8	$33,274,000

of this alternative include CDF construction; dredging of sediments with PCB concentration 50 ppm and above and disposal into CDFs; and water treatment of CDF effluents. A more detailed discussion of these cost components (including capital, O&M, and indirect costs) was presented in Subsection 2.2.6 for Alternative SW-7. Figure 2-9 illustrates the cost breakdown for each of the alternative components. The total estimated cost for Alternative SW-8 is $33.3 million dollars.

2.3.7 Compliance with ARARs

ARARs for the dredging and disposal components of Alternative SW-8 are the same as for Alternative SW-7. Chemical-specific ARARs for this alternative are presented in Subsection 4.2.2.1 of Volume I. It is anticipated that Alternative SW-8 would attain the AWQC for water column PCB concentrations at the end of ten years but would not attain the FDA tolerance level of 2 ppm for biota in all areas.

Massachusetts Surface Water Quality Standards (310 CMR 4.00) would apply to the treatment of the supernatant that will be generated when dewatering the dredged sediments. This regulation sets standards for maximum levels of contaminants that can be discharged to the surface waters of the state.

National Air Quality Standards (40 CFR 40) and Massachusetts Air Pollution and Air Quality Regulations (310 CMR 6.00-8.00) would apply to this alternative because no remedial action should cause a negative impact on existing air quality. Monitoring systems can be engineered into the implementation of this alternative to gauge whether dredging and disposal of the sediments cause volatilization of any contaminants. Any impacts detected would be prevented or minimized by best available engineering controls during dredging and disposal activities.

Dredging sediment would trigger federal and state location-specific ARARs for wetlands and floodplains. These ARARs are described in Subsection 4.2.2.2. Substantive requirements of Section 404 of the CWA and the USACE regulations at 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

If a functioning wetland with environmental value is negatively affected from a remedial action, mitigation techniques such as

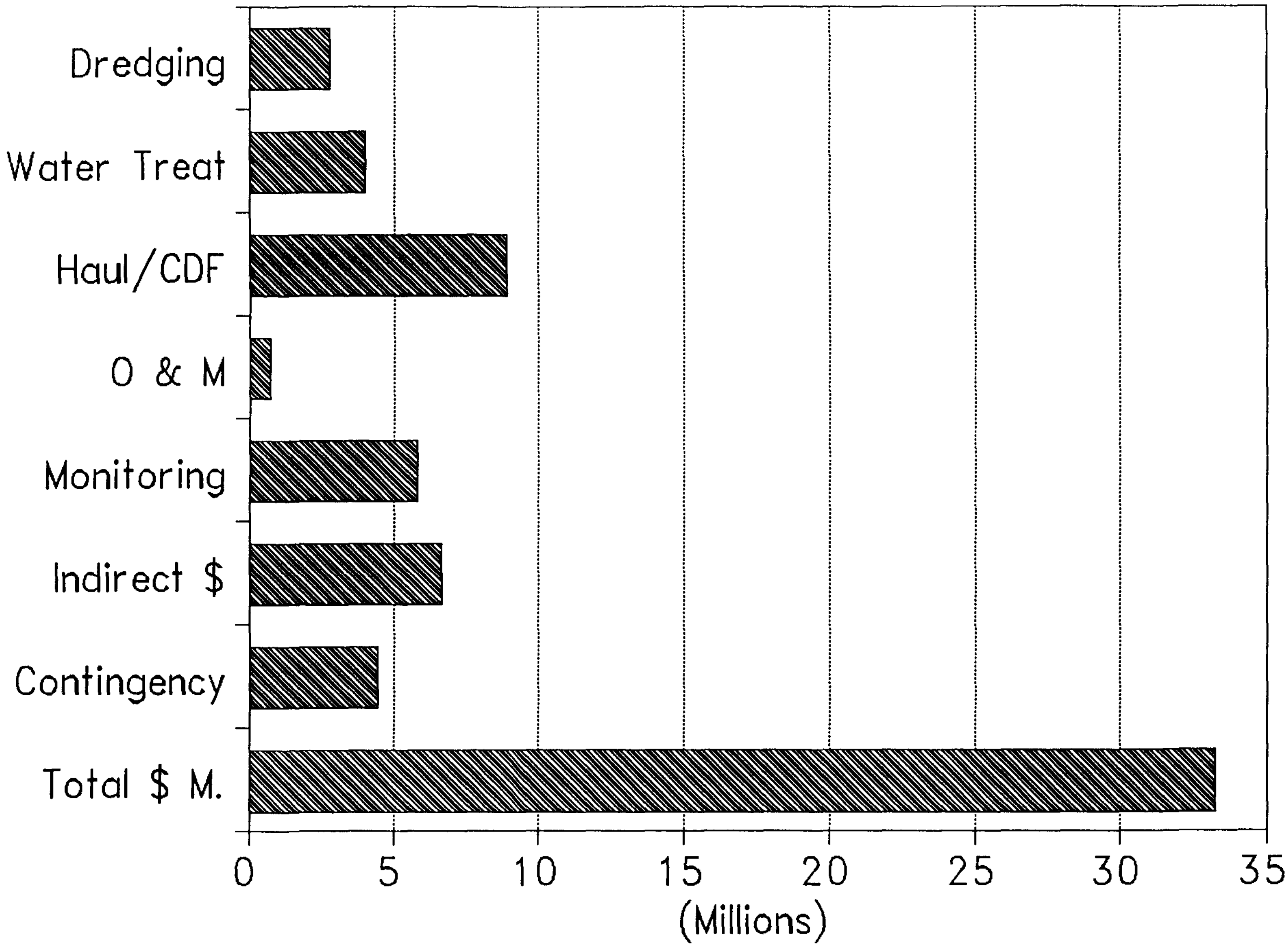


Figure 2-9

Cost Estimate SW-8
Estuary and Lower Harbor and Bay
Feasibility Study
New Bedford Harbor

wetland restoration, enhancement, or creation may be appropriate. Executive Orders 11988 and 11990 (see Subsection 4.2.2.2), which are implemented through NEPA (40 CFR Part 6, Appendix A), are ARARs that may also require wetlands and floodplain mitigation. If excavation of the wetlands is required, then restoration of wetlands would occur as part of the construction of this alternative. Reclamation of wetlands damaged or destroyed is included as an option to Alternatives EST-3 and LHB-3, and subsequent alternatives that potentially require dredging and excavation of estuary wetlands.

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetlands protection regulations apply. Compliance with substantive requirements would be met.

Several action-specific ARARs would go into effect during various phases of implementation of this alternative. Under the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00), dredging and transport of contaminated sediments to shore-based facilities would have to meet technology requirements set forth in these regulations. Dredging techniques are determined by the characteristics of sediments and material to be dredged. This material would be transported to shore using best engineering practices. The Administration of Waterways Licenses sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These requirements can be met through engineered controls implemented during construction. Dredging activities would be timed and coordinated to minimize interference with shipping and boating traffic, and a monitoring program would be implemented during dredging to detect and minimize the spread of contaminated sediments.

ARARs that pertain to the water treatment component of this alternative relate to either the O&M of wastewater treatment facilities (314 CMR 12.00) or treatment standards for process waters. Pilot test results indicate that treatment of the supernatant water generated during dewatering would meet promulgated treatment standards. Construction and operation procedures and standards would be attained through inclusion in the design and implementation of the alternative.

TSCA regulations (40 CFR 761) regulate the disposal of dredged materials contaminated with PCBs in concentrations of 50 ppm or more. This material must be incinerated to meet the performance requirements of 40 CFR 761.70, or placed in a chemical waste landfill in compliance with the technical requirements of 40 CFR 761.75. Alternative remedial actions may be approved by EPA if technical, environmental, and economic considerations indicate disposal in a federally permitted incinerator or chemical waste landfill is not reasonable or appropriate. Alternative disposal methods must provide adequate protection to human health and the environment.

Due to the heavy metal contamination, the dredged sediment may be considered a characteristic hazardous waste. Since these alternatives constitute "excavation/placement," RCRA Land Ban regulations (40 CFR 264.300-264.339) may apply.

Massachusetts Hazardous Waste Regulations (310 CMR 30.00) are relevant and appropriate to the design, construction, and O&M of the CDFs. In general, federal RCRA regulations govern these remedial activities. However, under CERCLA, more stringent state requirements (eg., 310 CMR 30.620-Landfills) supersede federal standards. To comply with 310 CMR 30.00, the CDFs would need to achieve a maximum permeability standard of $1x10^{-7}$ cm/sec. This alternative does not include a liner as part of CDF construction. Therefore, a waiver of this ARAR may be required.

Massachusetts Hazardous Waste Regulations also govern the closure and post-closure care of the CDFs. Closure requirements (310 CMR 30.580) state that a final cover must be designed and constructed to prevent migration of liquids, have minimal maintenance requirements, promote drainage, minimize erosion, and accommodate settling. The cover integrity should be maintained throughout the post-closure care period. The proposed containment system meets these requirements to the extent applicable and would be periodically monitored to assure its effectiveness.

In addition to the USACE administration of Section 404 of the CWA, the Massachusetts Wetlands Protection Act and regulations under 310 CMR 10.00 apply to all activities occurring in wetlands or in the 100-foot buffer zone. Similar to the federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is waived for all on-site activities. However, the local commission should be apprised of proposed activities and given the opportunity to review the draft New Bedford Harbor reports. Compliance with all substantive requirements of 310 CMR 10.00 and with the Massachusetts Water Quality Certification requirements at 314 CMR 9.00 is also required for activities involving dredging in wetlands or waterways.

All site activities, including monitoring, would be carried out pursuant to OSHA standards (i.e., 29 CFR 1904, 1910, and 1926) and Massachusetts Right-to-Know regulations (see Subsection 4.2.2.3).

2.3.8 Overall Protection of Public Health and the Environment.

Containment of contaminated sediment in the estuary and the lower harbor and bay areas by disposal in shoreline CDFs would effectively reduce the potential for direct contact exposure and limit the source of PCB contamination in surface water and biota. Reduction of shoreline sediment PCB concentrations to 50 ppm would provide an adequate level of protection to human health and a significant reduction in ecological risks over baseline conditions. The 50-ppm TCL is protective of older children and adults from direct contact exposure to sediments. Because young children are considered the most sensitive population, the residual risks associated with a 50 ppm TCL is greater than for older children and adults and is estimated at $5x10^{-5}$. This risk level is greater than the risk associated with a 10 ppm PCB TCL (e.g. $1x10^{-5}$), however, both risk values are within the EPA target risk range of $1x10^{-4}$ to $1x10^{-6}$.

PCB concentrations in the surface water and the biota in the estuary and lower harbor and bay are expected to decrease as a result of containment actions. However, because this alternative does not reduce the toxicity or volume of contaminated sediment, potential exists for risks to human health and environmental biota if the CDF fails. The magnitude of these risks would depend on the location and magnitude of any failure experienced.

Significant reductions in the MATCs for aquatic biota such as marine fish, mollusks, crustaceans, and algae would be achieved for a 50 ppm TCL at the end of ten years following remediation. Residual PCB concentrations in lobster and flounder would not be expected to fall below the 2 ppm FDA tolerance level in all areas while the residual PCB concentrations in lower food chain species such as hard clams, mussels, and crabs would be expected to fall below the FDA tolerance level. However, all residual PCB concentrations in these species would remain in excess of the human health-based 0.02 ppm RTL.

Short-term ecological impacts are expected. Benthic biota residing in the contaminated sediment would be destroyed during dredging of the estuary and the lower harbor and bay. The time required to fully recolonize these impacted areas is not known.

2.4 DESCRIPTION AND ANALYSIS OF ALTERNATIVE SW-9

2.4.1 General Description

Alternative SW-9 entails dredging the estuary to a TCL of 50 ppm PCBs, treating those sediment >500 ppm PCBs using either incineration or solvent extraction, and disposing of the treated and untreated sediments (50-500 ppm PCBs) in shoreline CDFs. Inaddition, sediment containing >50 ppm PCBs in the lower harbor and bay would also be dredged and disposed of in CDFs. Figure 2-10 presents a block diagram showing the components of Alternative SW-9.

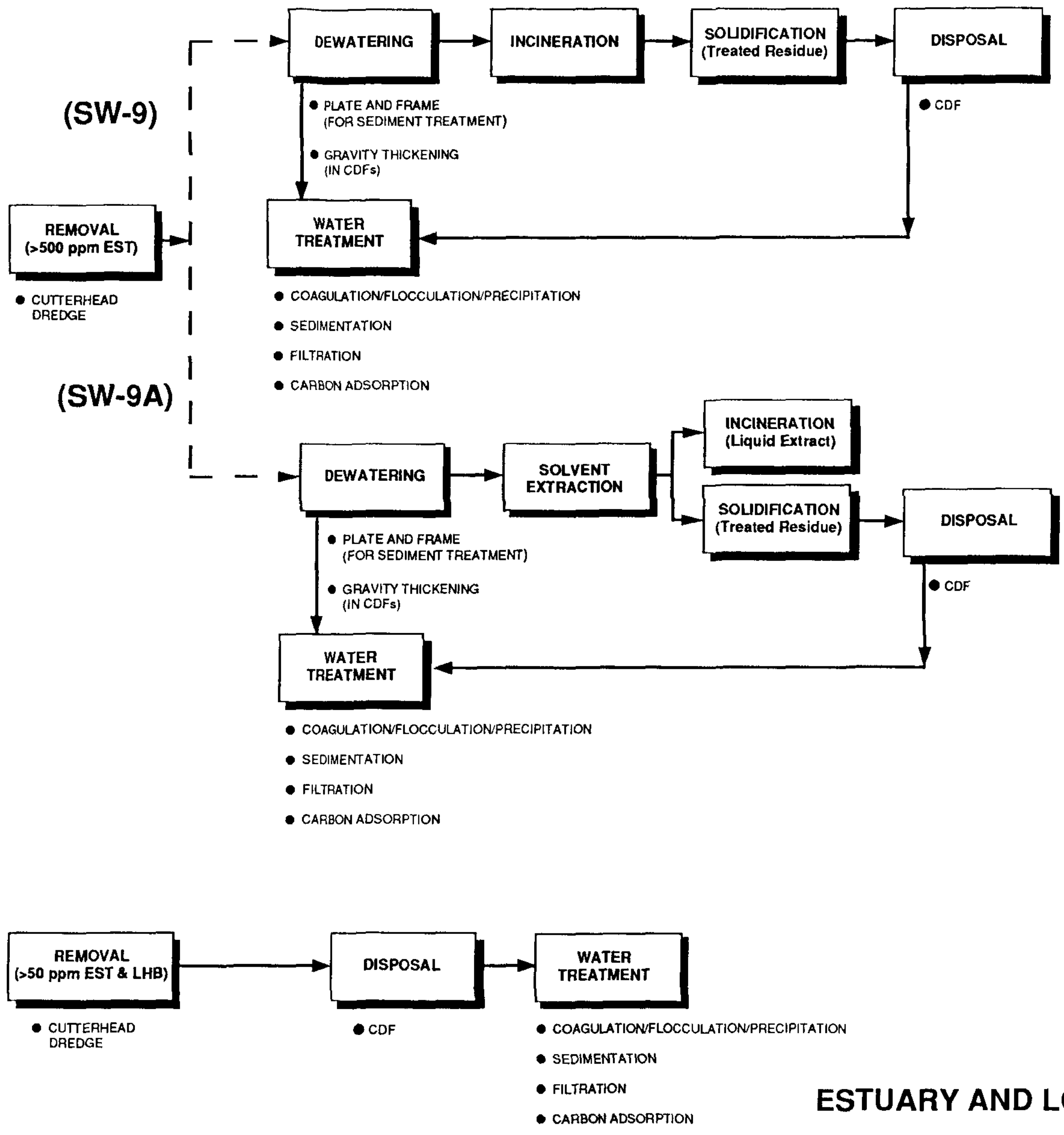
<u>CDF Construction.</u> Two CDFs would be constructed to contain the dredged treated and untreated material for this alternative: CDF 1, and CDF 1b. CDF 1 will be constructed approximately 2000 feet north of the Coggeshall Street Bridge in the cove on the western shore. CDF 1b would be constructed in the northern end of the estuary along the western shoreline. The location of these two CDFs are identified in Figure 2-11. Subsection 5.3.3 of Volume 2 describes CDF construction in greater detail.

<u>Dredging.</u> After construction of CDF 1 and mobilization of the sediment treatment system to the site, dredging of the contaminated sediment in the estuary could commence while CDF 1b is constructed. Approximately 46 acres of sediments in the northern estuary contain PCBs >500 ppm. Two cutterhead dredges making two passes to a total depth of one and a half feet in this area would remove a total volume of approximately 112,000 cy of sediment. A detailed discussion of dredging is contained in Subsections 5.3.1 and 7.4.1 of Volume II. The dredged >500 ppm PCB sediment slurry consisting of 2 to 4 percent solids would be pumped to a cell constructed within CDF 1 to isolate it from the less contaminated untreated sediment (<500 ppm) which would be disposed in the CDF.

After the sediment with >500 ppm PCBs have been removed, dredging of the remaining sediment >50 ppm PCBs could begin. Approximately 72 additional acres of sediment would need to be removed. Since CDF 1 is sited within this area requiring remediation, sediment lying within the CDF footprint would not be dredged. The remaining volume requiring dredging is 120,000 cy.

Dredging in the lower harbor and bay would commence once dredging operations in the estuary have been completed. Approximately 47 acres in four separate areas would be dredged to remove a total volume of 76,000 cy of sediment containing PCBs >50 ppm. Two areas are in the northern part of the harbor between the Route 6 Bridge and the Route I-195 Bridge. Two smaller areas immediately outside the Hurricane Barrier near the western shore. The sediment dredged in the northern part of the harbor would be hydraulically pumped to the disposal facility located adjacent to CDF 1 in the estuary.

The sediment dredged from outside the Hurricane Barrier would be collected in barges and transported up the harbor to the Route I-195 Bridge area. The dredged sediment would be hydraulically unloaded from the barges and pumped to the CDFs. Each barge is capable of carrying approximately 500 cy of material. Therefore, four barges would be needed to maintain the dredge output.



KEY

EST = UPPER ESTUARY
LHB = LOWER HARBOR AND BAY

FIGURE 2-10
ALTERNATIVE SW-9
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

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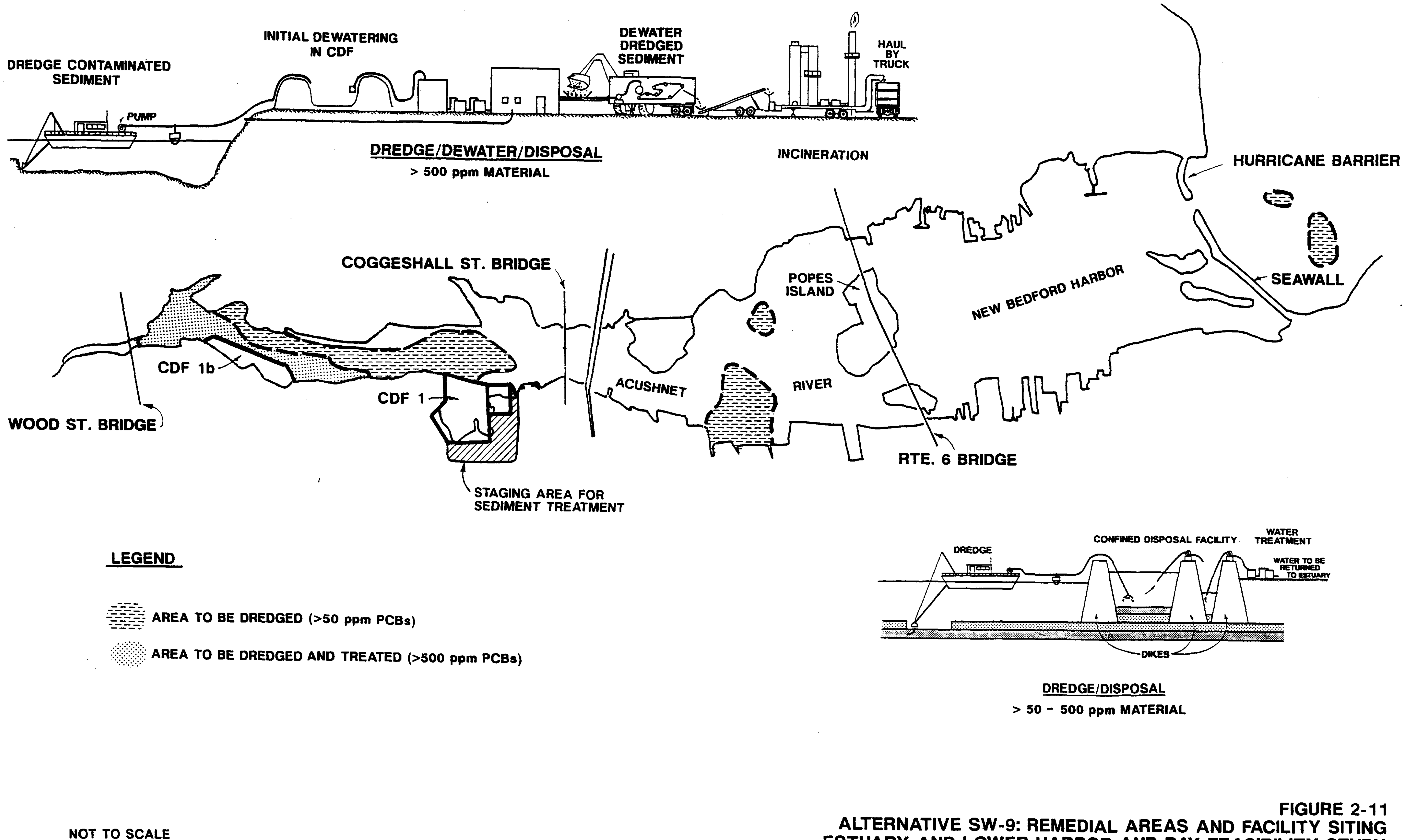

FIGURE 2-11
ALTERNATIVE SW-9: REMEDIAL AREAS AND FACILITY SITING
ESTUARY AND LOWER HARBOR AND BAY FEASIBILITY STUDY
NEW BEDFORD HARBOR

Dewatering/Water Treatment. Sediment dewatering and treatment of the CDF effluent would be conducted as described in Subsection 2.2.1.

Disposal. Disposal of dredged sediment and CDF closure would be conducted as described in Subsection 2.2.1.

Monitoring. A long-term monitoring program would be implemented as discussed for Alternative SW-7 (Subsection 2.2.1).

Dewatering/Water Treatment. The sediment slurry would dewater through gravity settling in the CDFs. The effluent would then be collected, pumped to a mobile water treatment plant and treated by the addition of coagulants, flocculants, and precipitators followed by either carbon adsorption or UV/oxidation prior to discharge back into the estuary. These processes are described in greater detail in Subsections 5.3.2.2 and 7.4.1 of Volume II. Sediment reserved for subsequent treatment (>500 ppm PCBs) would undergo a second dewatering step using a mechanical dewatering system such as a plate and frame filter press designed to produce a solids cake of approximately 50%. Effluent from the mechanical dewatering would be recycled back to the CDF water treatment system.

Sediment Treatment. Two technologies have been identified as applicable for the treatment of sediment containing PCBs >500 ppm: incineration and solvent extraction. These treatment technologies were incorporated as components of remedial alternatives which were evaluated in detail in Section 7.0 of Volume II. Both of these technologies are retained as treatment options for Alternative SW-9. Treatment of sediment employing incineration and solvent extraction are designated Alternative SW-9 and Alternative SW-9A, respectively. Each technology is discussed briefly in the following paragraphs. Figures 2-12 and 2-13 present mass balances for sediment treatment via incineration or solvent extraction, respectively.

Incineration - Dewatered sediment would be incinerated to destroy the PCBs. Numerous incinerator technologies are available for the destruction of PCBs in sediment including rotary kiln, infrared, and fluidized bed. These incinerators are capable of achieving 99.9999 percent destruction of contaminants, as required by federal standards. The ultimate selection of an incinerator would be determined during remedial design.

It is assumed that five skid or trailer-mounted 75 ton-per-day incinerator units or one large fixed unit would be used. Approximately two years would be required to incinerate the sediment in the estuary >500 ppm PCBs. Should fewer incinerators be used, the time for remediation would increase proportionately. The number of unit(s) has been determined such that treatment of the contaminated sediment can maintain the dredge output of 280 cy per day (345 tons/day). The five incinerator units would occupy a

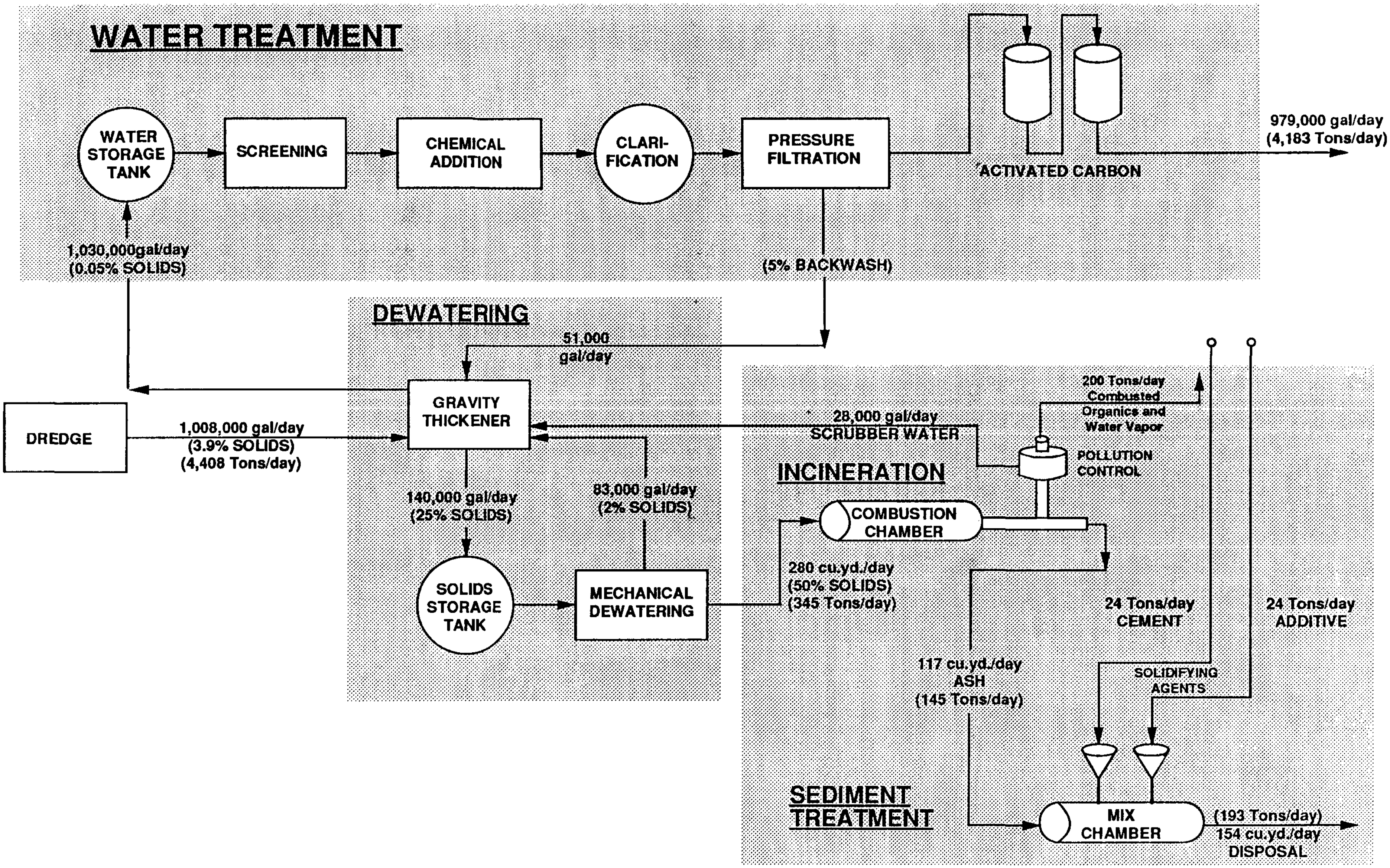

FIGURE 2-12
ALTERNATIVE SW-9:
MASS BALANCE FOR INCINERATION
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

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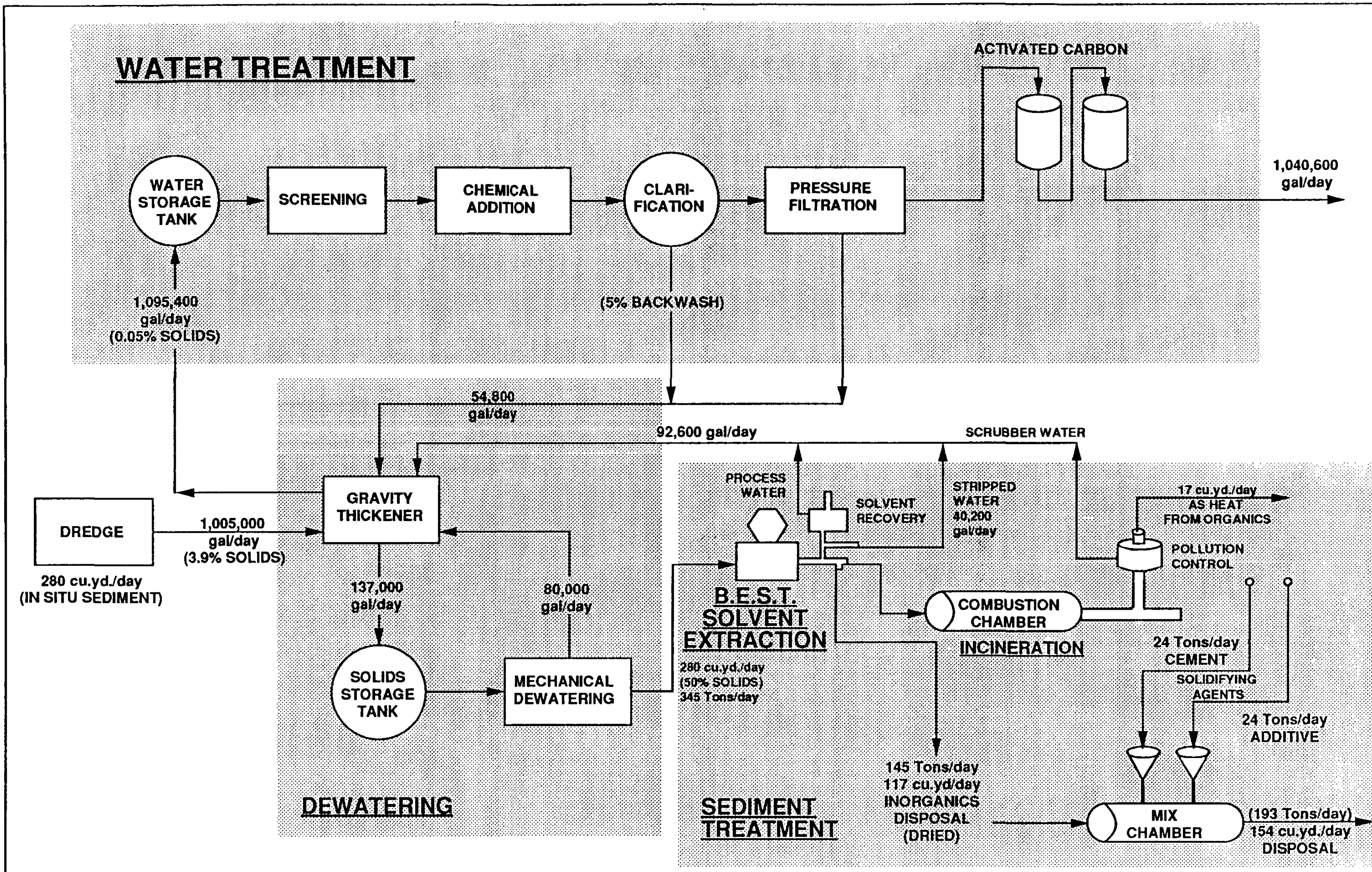


FIGURE 2-13
ALTERNATIVE SW-9A:
MASS BALANCE FOR SOLVENT EXTRACTION
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

total area of 6 to 8 acres. Sediment entering the incinerator would be 50 percent solids by weight. An auxiliary fuel (e.g., fuel oil or natural gas) would be added to the sediment feed to facilitate combustion. Details on the operational parameters including air pollution control are presented in Subsection 7.7.1 of Volume II.

Incineration of the PCB-contaminated sediment would produce a large amount of residual ash (approximately 47,000 cy), which would contain metals at concentrations near those observed in the untreated sediment. These metals may become oxidized as a result of incineration, thereby allowing them to become more mobile. TCLP analysis would be conducted on the ash to determine whether metals leaching from the ash would exceed the maximum allowable leachate concentrations, thereby constituting a hazardous waste. If the ash fails the leaching test, solidification would be necessary as a secondary treatment step to immobilize the metals.

Solidification would be used as a secondary treatment to physically and chemically stabilize the metals by binding them in a solid matrix. This treatment is a common technology for stabilizing metals. Therefore it is anticipated that among the numerous commercial processes available, a formulation of solidifying agents is available to immobilize all heavy metals. Additional bench-scale tests to determine the correct formulation would be required before final design.

Solidification of the incinerator ash would be accomplished using conventional cement-mixing equipment. Based on a 50 percent solids feed containing 8 percent combustible organics in the feed, 117 cy of residual ash would be generated for every 280 cy of sediment incinerated (345 tons). Adding 0.3 tons of solidifying agent to every ton of incinerator ash would produce approximately 193 tons per day of solidified ash. This is equivalent to approximately 154 cy of residual material, with an assumed density of 1.25 tons per cy (Church, 1981).

Solvent extraction - Solvent extraction is a process in which a soluble substance is leached from a solid matrix with an appropriate solvent. Although PCBs characteristically have relatively low solubilities in water, they are readily soluble in certain organic solvents under appropriate conditions of temperature and/or pressure.

Several solvent extraction technologies are currently being developed to treat PCB contaminated soils and sediments. Two solvent extraction technologies were evaluated in detail for the New Bedford Harbor FS: the TEA-based BEST process developed by RCC; and the liquified (gas) propane process developed by CF Systems. Detailed discussions of these technologies are presented in Subsections 5.4.2 and 7.6.1 of Volume II. In the following paragraphs, Resource Conservation Company's (RCC) BEST process has been selected as the example technology for detailed evaluation of sediment treatment using solvent extraction.

Solvent extraction of PCBs (and the associated oil fraction) from the estuary and lower harbor/bay sediment would begin by batch mixing the dewatered sediment with the appropriate solvent; in the BEST process, the solvent is triethylamine (TEA). After mixing, the solvent containing PCBs and the sediment containing little or no residual PCBs would be separated by centrifugation and/or gravity settling. The PCB/oil fraction is then separated from the solvent, either by changing the temperature and/or pressure of the solvent which changes the solubility of the PCBs, or by distillation methods. The solvent is subsequently recycled and the PCB/oil fraction is destroyed via incineration.

The sediment processing hardware consists of Littleford TM rotary washer-dryer units. These units are readily available and are used extensively in the chemical-processing industry. Throughput rate for one solvent extraction unit is assumed to be 75 tons (i.e., 61 cy) of dewatered sediment per day. Five units would be necessary to maintain the dredge output rate, and would occupy a total area of approximately 2 acres. One large-capacity unit may be constructed to replace the five smaller ones. The dewatered sediment would be separated into three distinct effluent streams: sediment solids, water, and an extract containing PCBs and oil. Approximately 117 cy of dry sediment solids would be generated per day. These solids may contain residual metals. Leaching tests would be used to determine the need for secondary treatment, such as solidification to immobilize the metals, prior to ultimate disposal. The 40,000 gpd of water removed from the sediment would be pumped to the water treatment facility (see Subsection 7.3.1 of Volume II).

Approximately 28 tons per day of PCB/oil extract would be generated. Because of the duration of this project (i.e., two years) and the high cost of hauling the oil to a licensed facility, a small mobile incinerator would be sited to treat the PCB/oil extract. Due to the relatively high Btu content and straightforward material handling, the requisite destruction and removal efficiencies (DREs) should be readily achievable.

<u>SW-9 Schedule.</u> Once remedial design activities have been completed and all land acquisition or site access rights have been obtained, this alternative is anticipated to take six years to complete. Construction of CDF 1 and the treatment facilities would take approximately one year to complete. Dredging 308,000 cy would take approximately five years to complete. During this time CDF 1b would be constructed. As discussed in the SW-8 schedule, this dredging timeframe may be conservative, especially when dredging in the lower harbor and bay. The six year period also includes capping and seeding the CDFs once dredging is complete.

2.4.2 Short-term Effectiveness

Minimal risk is anticipated to both workers and the surrounding community during implementation of this alternative for the reasons discussed in Subsection 2.2.2. Appropriate monitoring of airborne or volatilized contaminants would be conducted during all dredging and disposal operations and control measures would be implemented. Workers on-site during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborn particulates or volatilized contaminants as a result of dredging operations (e.g. clearing debris from or unclogging the dredgehead), sediment dewatering, and sediment treatment (e.g., contact with the TEA solvent and PCB/oil fraction; inhalation of fugitive emissions from the incinerator).

Dredging is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed and destroyed during the dredging operation. Although it is expected that this area would rapidly reestablish itself, this process could be enhanced through a recolonization program.

Transport of dredged sediment to the disposal facility via the hydraulic pipeline is not expected to affect the environment; however, the pipeline would be designed to prevent and be continously monitored for leakage.

2.4.3 Long-term Effectiveness and Permanence

The long-term effectiveness of dredging sediment in the upper estuary and the lower harbor and bay to remove PCBs is discussed under Alternative SW-8 (see Subsection 2.3.3).

Incineration is a proven technology for the destruction of organics, and is therefore expected to provide a complete and permanent remedy for treating PCB-contaminated sediment. Solidification as a secondary treatment for the incinerator ash is expected to provide an effective means of immobilizing metals if the ash fails the leaching test. However, the long-term permanence of solidification is uncertain because limited long-term performance data exist to address this issue.

Bench-scale tests conducted on New Bedford Harbor sediment indicate that solvent extraction can effectively remove more than 99 percent of the sediment PCBs. However, the processed sediment may require secondary treatment to immobilize metals that would not be extracted. Limited data are available to assess full-scale operation of solvent-extraction technologies.

Disposal of processed sediment in the unlined CDF is not expected to present long-term risks to human health or the environment. Processed sediment containing residual PCBs and metals, combined with the untreated sediment of 50 to 500 ppm, would constitute the only source of contamination that could potentially be reintroduced into the environment. However, the concentration of PCBs and metals in any leachate generated is expected to be less than if no treatment was conducted. Placement of a cap on the CDF would reduce the potential for leachate generation due to infiltration of precipitation and surface runoff. Furthermore, attenuation of any residual-contaminated leachate would be expected if leachate generated migrates through the earthen dikes of the CDF. Long-term monitoring and maintenance of the CDF cover and monitoring of the CDF dike would be necessary to assess leachate migration and contaminant concentration.

2.4.4 Reduction in Mobility, Toxicity, and Volume

Incineration of contaminated sediment would permanently destroy PCBs, thereby reducing both toxicity and mobility. Incineration would also reduce the final volume of sediment by destroying the organics and vaporizing the water retained in the filter cake (after dewatering).

Solvent extraction would provide a reduction in both the mobility and volume of PCBs by physically removing them from the sediment. A reduction in PCB toxicity would be achieved by incineration of the PCB/oil extract.

Solidification of processed sediment may be required as a secondary treatment to immobilize residual PCBs and metals. Solidification would achieve a reduction in mobility of the residual PCBs and metals, but would increase the volume of processed residual solids depending on the formulation used.

Disposal of untreated contaminated sediment in the CDFs is expected to reduce the potential migration of PCBs and metals. However, long-term of the CDFs cannot be assessed due to the limited amount of monitoring data. Therefore, a possibility exists for leachate to migrate from the CDFs.

2.4.5 Implementation

2.4.5.1 Technical Feasiblity

Constructability. The constructability of the dredge and disposal portions of this alternative is similar to Alternative SW-7 (see Subsection 2.2.5.1).

Incineration is technically feasible and has been proven for destruction of organic compounds, including PCBs in soil, over a range of contaminant levels similar to those in New Bedford Harbor. The sediment is not expected to have significant energy content; therefore, auxiliary fuels would be required to achieve the necessary temperatures.

Solvent extraction has been demonstrated to be technically feasible for treating New Bedford Harbor sediment. However, limited performance data are available on the ability to scale up solvent extraction to treat 280 cy of sediment daily. Pilot-scale tests of this treatment technology are warranted prior to implementation. Incineration of the PCB/oil extract is currently the most widely used technology for the destruction of PCB materials.

Solidification of the solid process residuals is a common method for reducing the mobility of metals in solid matrices. The process would result in a material that can be easily handled and is stable for disposal.

Reliability. The reliability of the dredging and disposal portion of this alternative is similar to Alternative SW-7 (see Subsection 2.2.5.1).

Incineration systems are highly reliable due to the sophistication of the technology employed and the degree of monitoring and control practiced. A DRE of 99.9999 percent for various organic compounds and PCBs has been demonstrated. A trial burn would need to be completed before implementation to optimize operating parameters. Typical downtime estimates for incinerators are 20 to 30 percent for a system operating 24 hours per day, seven days per week; this is required for systems maintenance and inspections.

RCC recently completed a pilot-scale demonstration of its new process hardware system at a CERCLA site in Greenville, Ohio. A 10-gallon Littleford unit was used to treat PCB-contaminated soils; the same unit used by Littleford to pilot-test operational and design parameters before full-scale implementation. Results of RCC's tests at the Greenville site indicated that soils contaminated with 150 ppm PCBs were reduced to less than 5 ppm PCBs using the new process system (Weimer, 1990).

Support and Installation. Close coordination with the Harbor Master would be required during dredging activities within the harbor to minimize or avoid impacts on commercial shipping traffic. Tugs, tow vessels, and trucks would be required to move the cutterhead dredge to designated areas. Construction of the hydraulic pipelines would require floating pipes and support crews and vessels.

The incineration process requires a pretreatment step to dewater sediments and post-treatment for the ash, scrubber water, and gaseous effluents. These treatment steps would be necessary to comply with ARARs and other institutional constraints.

Before passing sediments through the incinerator, dewatering is necessary to remove as much water from the sediments as possible. Heat required to evaporate the water in the combustion chamber represents a large fraction of the total heat necessary to incinerate the sediments. Reducing the amount of water in the slurry will have two benefits: first, the fuel saved by not evaporating the water represents a direct savings in operating cost; and second, the time required to process the sediments is reduced, resulting in higher throughputs and less total operating time. For the purpose of this evaluation, a dewatering step involving mechanical dewatering is assumed and the process is evaluated under water-feed conditions of 50 percent solids and 50 percent water by weight.

Ease of Undertaking Additional Remedial Actions. No remedial actions are anticipated following incineration of the sediment because the organics would be destroyed. The heavy metals in the residual ash are expected to be immobilized by solidification following treatment operations, if necessary. No additional remedial actions are anticipated if the solvent extraction process is successful. However, if solvent extraction does not work on the New Bedford Harbor sediment, mobile incinerators could be brought on-site to treat the dredged material.

2.4.5.2 Administrative Feasibility

Coordination among the lead agency (i.e., USACE or EPA), the City of New Bedford, and the Commonwealth of Massachusetts will be important. Coordination would involve active communication, including formal and informal meetings, among these agencies at critical points in the remedial action process. Because no activities would be conducted off-site, permits would not need to be obtained for these alternatives. Although solvent extraction is a relatively new technology, significant opposition from the various agencies is not expected.

2.4.5.3 Availability of Services and Materials

The availability of services and materials for dredging, dewatering, water treatment, and CDF construction is discussed in Subsection 7.4.5. Mobile incineration units capable of treating 75 tons of sediment per day are currently available. Approximately five infrared incinerators, five rotary kilns, and two fluidized bed units will be available in 1990. Any of these units could be mobilized on-site within a two-month period. RCC is currently completing the design for a 75 cy per day processing unit using the Littleford rotary washer-dryer. Equipment delivery is estimated to be 40 weeks after order placement.

2.4.6 Cost

Table 2-5 presents the capital and O&M costs for Alternative SW-9. Land acquisition costs have not been included. Separate cost components of the alternative include (1) dredging, (2) dewatering and water treatment, (3) incineration, (4) solvent extraction of the dewatered sediments and treatment of the extracted PCB oils (SW-9A) (5) material transport, and (6) disposal into shoreline CDFs. Each component has been scaled to accommodate the daily dredge output of 280 cy in situ (50 percent solids by weight). Details on the costs of dredging, dewatering/water treatment, and CDF construction are discussed in Subsection 2.2.6. The total estimated cost of Alternatives SW-9 and SW-9A is $93.0 million dollars and $80.6 million dollars, respectively.

Figures 2-14 and 2-15 provide a breakdown of the costs of this alternative. The costs for incineration include equipment and materials necessary to burn the PCBs contained in the dewatered sediment. The actual costs are based on vendor information and cost bids for similar clean-up work. Costs are given per ton treated and reflect estimates from nine separate sources. The actual costs vary depending on the amount of material that will require treatment. The costs include capital and O&M costs, mobilization/demobilization costs, contingencies, and profit. Included in the cost of sediment treatment is solidifying the residual ash to immobilize the metals present.

The costs for solvent extraction include equipment and materials necessary to extract the PCBs from the dewatered sediment. The actual costs are based on a bench-scale study conducted by RCC's BEST process using TEA as the solvent to separate the sediment into water, solids, and organics fractions. Using scale-up factors, RCC determined five 100-ton-per-day units would be required to maintain the dredge output rate. Mobilization/demobilization costs are considered in the process costs, as well as incineration of the spent carbon and treatment of the water at the water treatment plant.

Health and safety costs, where not included as part of a line item within a given component, have been added as other direct costs. For this alternative, Level D health and safety factors were added to the water treatment and material transport components at 5 percent of the overall cost of that item.

Other costs have also been added to the total cost of implementing this alternative. Legal, administrative, and permitting costs are anticipated to add an additional 6 percent of the total capital and O&M costs. Engineering and services during remediation are anticipated to cost an additional 10 percent each. Turnkey contractor fees are anticipated to cost 15 percent. Finally, a 20 percent contingency was added to the subtotal of these items to

TABLE 2-5

COST ESTIMATE: ALTERNATIVE SW-9/9A
DREDGE/INCINERATE or SOLVENT EXTRACT/DISPOSE
NEW BEDFORD HARBOR

ACTIVITY	COST (incineration)	COST (solvent extr.)
I. DIRECT COSTS		
A. Dredging	$3,292,000	$3,292,000
B. Dewater/Water Treatment	$7,090,000	$7,090,000
C. Sediment Treatment	$42,762,000	$34,124,000
D. Material Hauling	$312,000	$312,000
E. CDF Construction	$6,815,000	$6,815,000
DIRECT COST	$60,271,000	$51,633,000
II. INDIRECT COSTS		
A. Health & Safety (@ 5%) Level D Protection [Activities: B,D]	$370,000	$370,000
B. Legal, Administration, Permitting (@ 6%)	$3,616,000	$3,098,000
C. Engineering (@ 10%)	$6,027,000	$5,163,000
D. Services During Construction (@ 10%)	$6,027,000	$5,163,000
E. Turnkey Contractor Fee (@ 15%)	$9,041,000	$7,745,000
INDIRECT COST	$25,081,000	$21,539,000
SUBTOTAL COST	$85,352,000	$73,172,000
CONTINGENCY (@ 20%)	$17,070,000	$14,634,000
TOTAL CAPITAL COST	$102,422,000	$87,806,000
PRESENT WORTH COST - 1989 (@ 5% for 6 years)	$86,644,000	$74,279,000
O&M COST (CDFs) (present worth @ 5% for 30 years upon completion)	$538,000	$538,000
MONITORING PROGRAM (present worth @ 5% for 30 years)	$5,817,000	$5,817,000
TOTAL COST - ALTERNATIVE SW-9/9A	$92,999,000	$80,634,000

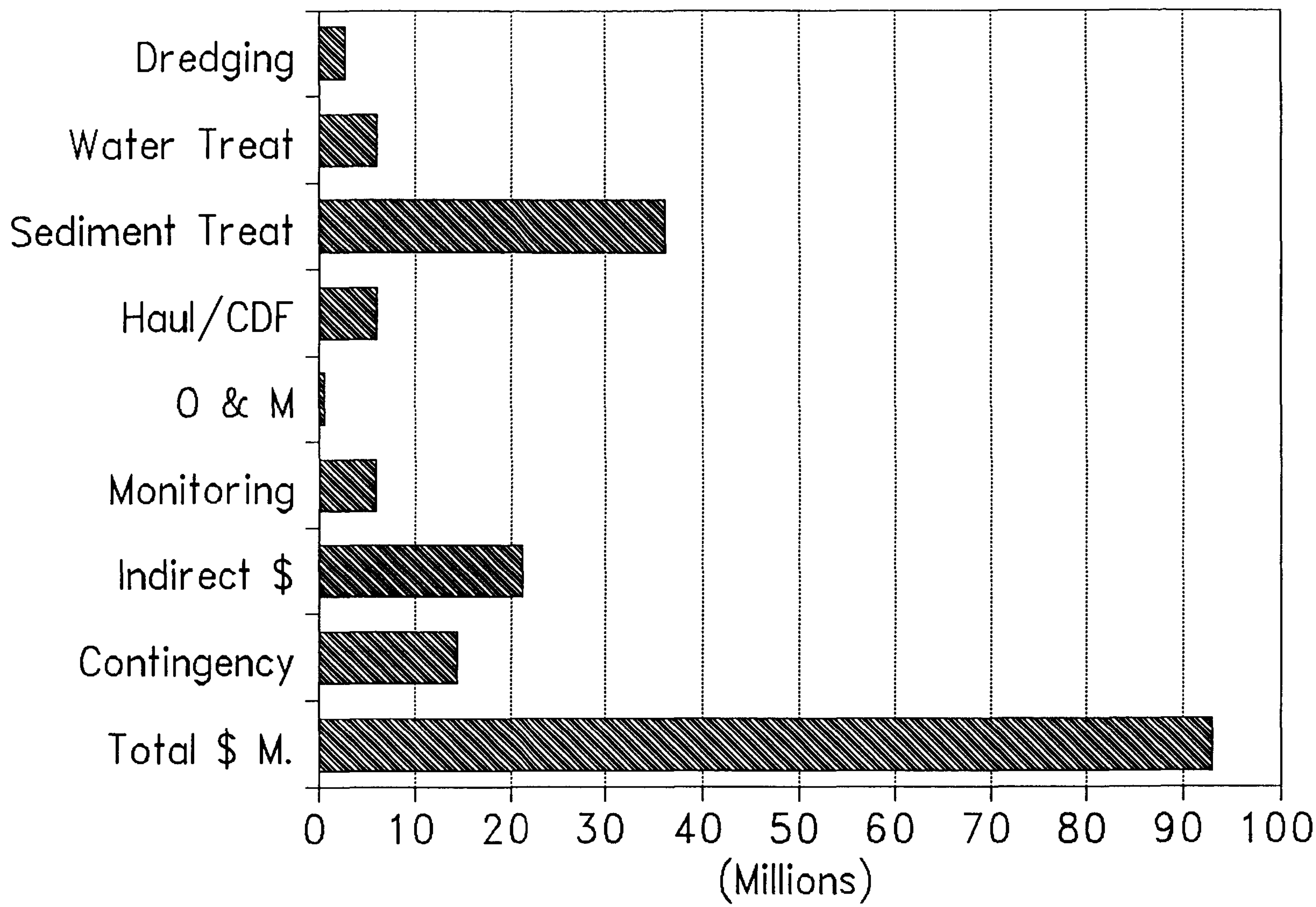


Figure 2-14

Cost Estimate SW-9
Estuary and Lower Harbor and Bay
Feasibility Study
New Bedford Harbor

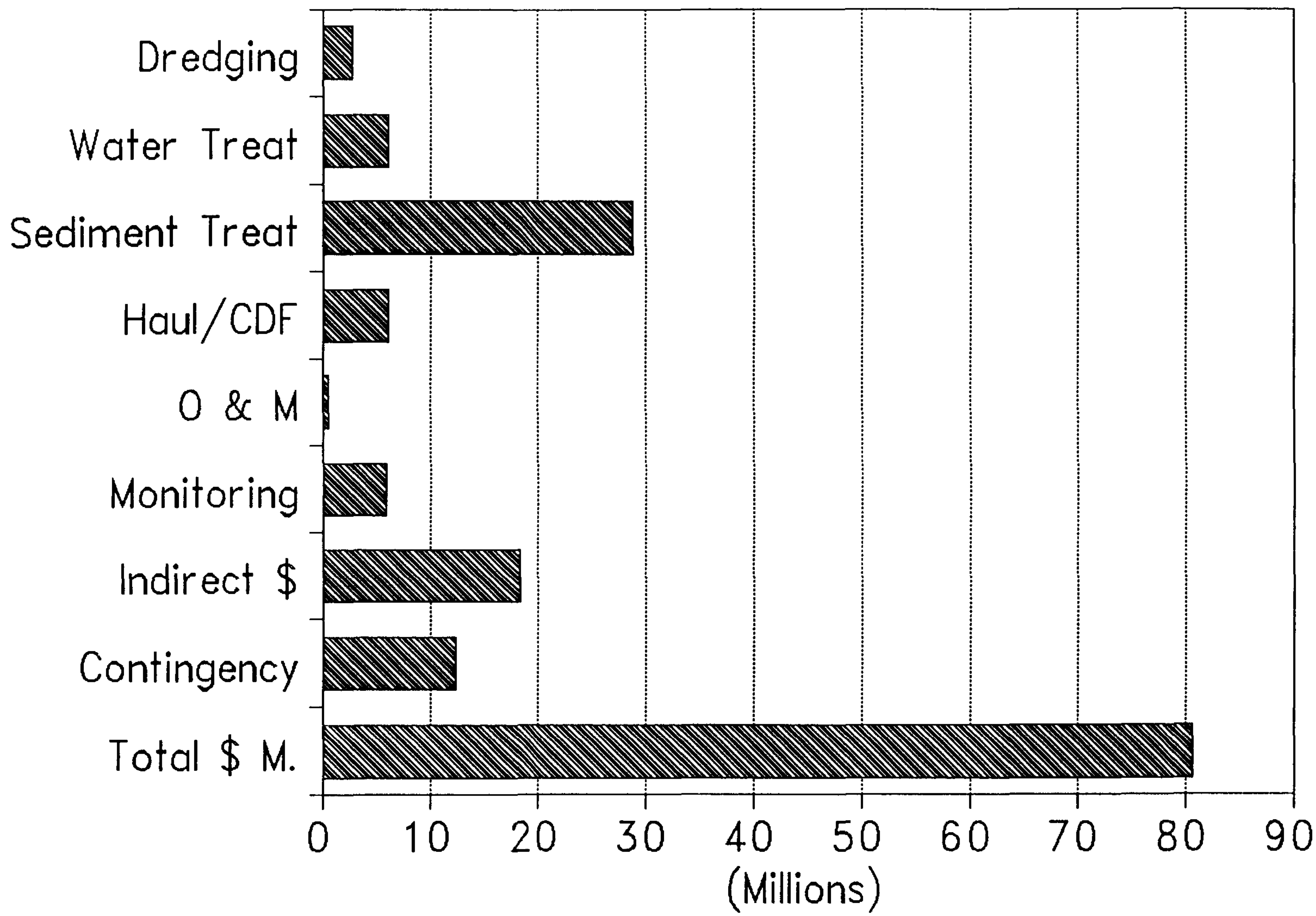


Figure 2-15

Cost Estimate SW-9a
Estuary and Lower Harbor and Bay

Feasibility Study
New Bedford Harbor

derive the final cost per alternative. The indirect costs and contingency are based on standard engineering practices using undeveloped design conditions.

2.4.7 Compliance with ARARs

Compliance with chemical-specific ARARs pertaining to surface water and aquatic biota is discussed in Subsection 2.3.7. Incinerator air emissions would be subject to federal National Air Quality Standards (40 CFR 40) and Massachusetts Air Quality Regulations (310 CMR 6.00-8.00). Under these requirements, air emissions would need to be treated by BACT. Remedial actions should not result in impacts that degrade existing air quality.

Location-specific ARARs applicable to the wetlands and floodplains of the estuary and the lower harbor/bay are discussed in Subsection 2.3.7. Action-specific ARARs triggered by dredging, disposal, and dewatering of contaminated sediments are identified in Subsection 2.3.7. The actions discussed as necessary to comply with those ARARs would apply to this alternative as well.

TSCA regulations would be appropriate to the design and performance requirements of the incineration facility (40 CFR 761.70). Under TSCA, test burns are required before full-scale operation. Upon EPA approval of the incinerator, operation must be conducted in compliance with technical standards outlined in TSCA, including a 99.9999 percent DRE.

Incinerated sediments would undergo TCLP analysis. Material failing TCLP maximum concentration would be subject to RCRA disposal requirement (40 CFR 264.300-264.339) (Land Ban) and Massachusetts Hazardous Waste Regulations. These ARARs are discussed in detail in Subsection 7.5.7 of Volume II.

All site activities, including monitoring, will be carried out pursuant to OSHA standards (29 CFR 1904, 1910, and 1926) and Massachusetts Right-to-Know regulations (see Subsection 4.2.2.3 of Volume II).

2.4.8 Overall Protection of Public Health and the Environment.

Removal and treatment of contaminated sediment with PCB concentration >500 ppm in the upper estuary using incineration or solvent extraction would permanently reduce the mobility, toxicity, and volume of a substantial fraction of the total PCB mass. The human health and environmental risks directly associated with this PCB mass would be significantly reduced.

Containment of contaminated sediment in the estuary and the lower harbor and bay areas by disposal in shoreline CDFs will effectively reduce the potential for direct contact exposure and limit the source of PCB contamination in surface water and biota. Reduction of shoreline sediment PCB concentrations to 50 ppm will provide an adequate level of protection to human health and a significant reduction in ecological risks over baseline conditions. The 50 ppm TCL is protective of older children and adults from direct contact exposure to sediments. Because young children are considered the most sensitive population, the risks associated with a 50 ppm TCL are greater than for older children and adults at $5x10^{-5}$. However, the risk level for the 50 ppm TCL is within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

PCB concentrations in the surface water and the biota in the estuary and lower harbor and bay are expected to decrease as a result of containment actions. Although this alternative reduces the mobility, toxicity, and volume of contaminated sediment >500 ppm, potential exists for risks to human health and environmental biota if the CDF containing sediment <500 ppm PCBs fails. The magnitude of these risks would be depend on the location and magnitude of any failure experienced.

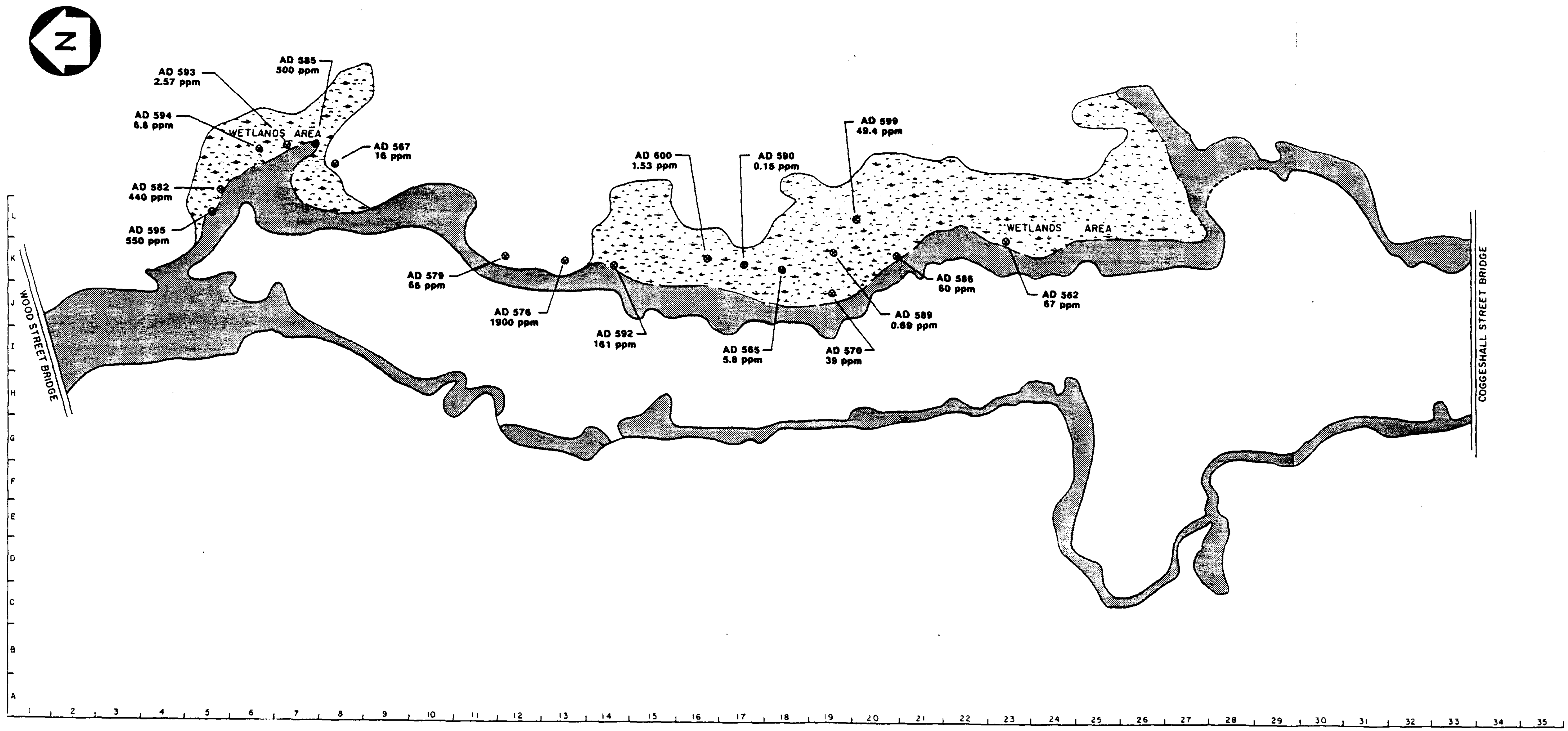
Short-term ecological impacts are expected. Benthic biota residing in the contaminated sediment would be destroyed during dredging of the estuary and the lower harbor and bay. The time required to fully recolonize these impacted areas is not known.

2.5 REMEDIATION OF WETLANDS

Figure 2-16 identifies the mudflat and saltmarsh areas located in the Acushnet River Estuary. Based on limited samples collected within the saltmarsh areas, the general trend shows higher levels of PCBs (requiring remediation) are located on the fringe areas between the mudflats and the saltmarsh. The one exception is a localized area within the USACE grid K13 where a PCB concentration of 1900 ppm was measured.

The remedial alternatives identified in Section 2.0 include remediation of the mudflats since they are located within the 4 foot MLW, which defines the site boundary. Remediation of the saltmarsh fringe areas and one isolated location in the saltmarsh where the 1900 ppm PCB sample was identified would achieve the 50 ppm TCL. Further sampling may be required to better define the areal extent of contamination in this grid during the remedial design activities. Removal of these saltmarsh areas would be limited to approximately 7,000 additional cy over a 3 acre area. Based on the extent of excavation in this area, the appropriate level of mitigation would be implemented.

A preliminary cost of $600,000 was estimated for remediating the additional 3 acres of saltmarsh. This estimate includes costs for: remedial planning, dredging, saltmarsh reconstruction, and re-



LEGEND

- WATER LIMITS
- EXPOSED MUDFLATS } WETLANDS
- SALTMARSH } WETLANDS
- ⊗ USACE GROUP 2 SAMPLES

0 400 800 1200 FEET

FIGURE 2-16
PCB WETLAND SAMPLING LOCATIONS
ESTUARY AND LOWER HARBOR AND BAY
FEASIBILITY STUDY
NEW BEDFORD HARBOR

**TAKEN FROM USACE SPEC. NO. DACW 33*

establishment of vegetation. It is assumed that space is avaialble in existing CDFs for disposal of dredged saltmarsh material.

3.0 COMPARISON OF SITE-WIDE ALTERNATIVES

A comparative analysis was conducted to evaluate the performance of each of the three site-wide alternatives relative to each evaluation criterion. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that EPA can identify key trade-offs to facilitate its Selection of Remedy process. A discussion of the comparative analysis is presented for each criterion in the following subsections. Table 3-1 summarizes the comparative analysis of the site-wide alternatives.

3.1 SHORT-TERM EFFECTIVENESS

Short-term effectiveness refers to the alternative's effect on human health and the environment during implementation of the remedial alternative. The site-wide alternatives evaluated in Volume III would present limited short-term risks to human health and the environment. All three alternatives involve removal of contaminated sediment. Protective clothing would be worn by workers to prevent dermal contact during dredging and handling, and air quality controls would be utilized to minimize exposure to volatilized contaminants. Procedures and controls, developed and tested by USACE during the Pilot Dredging Study, would be employed to minimize environmental impacts due to sediment resuspension.

Alternative SW-7 may present a limited opportunity for worker exposure to contaminated sediment during capping activities such as the placement and anchoring of the geotextile. Sediment resuspension during cap placement would be closely monitored to minimize environmental impacts.

The treatment technologies proposed as a component of Alternative SW-9 are closed-system processes. Consequently, there is little risk associated with these treatment options. Incineration (as an auxiliary treatment for the concentrated PCB fraction produced during solvent extraction) and as a principal treatment technology has minimal risks provided operations are carefully controlled. Incinerator operations, particularly emissions, would be closely monitored.

3.2 LONG-TERM EFFECTIVENESS AND PERMANENCE

The long-term effectiveness and permanence criterion addresses the remaining risk after the site has been remediated. All three site-wide alternatives employ a containment component (i.e., capping or disposal in shoreline CDFs) which would effectively reduce the flux of PCBs into the water column and prevent direct contact exposure.

TABLE 3-1
SUMMARY OF THE COMPARATIVE ANALYSIS OF THE ADDITIONAL SITE-WIDE REMEDIAL ALTERNATIVES
ESTUARY AND LOWER HARBOR/BAY FEASIBILITY STUDY

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
Reduction of toxicity, mobility, or volume.	No reduction in toxicity, mobility, or volume. Containment of contaminated sediment in CDFs or via capping is expected to reduce the potential migration of PCBs and metals.	No reduction in toxicity, mobility, or volume. Containment of contaminated sediment in CDFs is expected to reduce the potential migration of PCBs and metals.	Reduction in toxicity, mobility and volume of PCBs in sediments containing >500 ppm PCBs which are treated via incineration or solvent extraction. Volume of treated residue increased by solidification. Containment of untreated contaminated sediment is expected to reduce the potential migration PCBs and metals.
Short-term Effectiveness			
o Time until protection is achieved	Reduction in human health risk should occur immediately after cap placement and consolidation, and removal of sediment for disposal in CDFs. Significant reduction in water column PCB concentrations. Time required to achieve protection of biota depends on benthic recolonization of new cap surface.	Reduction in human health risk should occur immediately following sediment removal. Significant reduction in water column PCB concentrations and subsequent reduction in biota.	Same as Alternative SW-8
o Protection of Community during Remedial Actions.	No impact is expected to the community during capping activities. Dredge controls and air quality controls would minimize community impacts during dredging and CDF disposal operations.	Dredge controls and air quality controls would minimize community impacts during dredging and CDF disposal operations.	Same as Alternative SW-8

TABLE 3-1
Continued

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
o Protection of Workers during Remedial Actions.	Minimal risk to workers during capping activities. Protection required against normal contact with dredged sediments, fugitive dust and volatilized contaminants during dredging and disposal operations.	Protection required against dermal contact with dredged sediments, fugitive dust and volatized contaminants during dredging and disposal operations.	Same as Alternative SW-8. Appropriate worker protection required for both incineration and solvent extraction, and solidification of treated residue.
o Environmental Impacts	Destruction of benthic community during capping activities or sediment dredging. Sediment resuspension expected during capping activities.	Destruction of benthic community during sediment dredging. Minimal environmental impact expected from dredging or CDF construction.	Same as Alterntive SW-8
Long Term Effectivness			
o Magnitude of Residual Risk	Potential risks remain because contaminated sediment remains on site under cap or stored in shoreline CDFs.	Potential risks remain became contaminated sediment remains on site in shoreline CDFs	Same as Alternative SW-8, Minimal risks remain for treatment of sediment with PCBs >500 ppm.
o Adequacy of Controls	Annual monitoring and maintenance of cap and CDF is required. CDF construction is well-proven.	CDF construction is well-proven. Annual monitoring and maintenance would be required.	Same as Alternaive SW-8. No special provisions for long-term management of treatment residuals is expected.

TABLE 3-1
Continued

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
o Reliability of Controls	Reliability concerns due to potential for cap failure or disturbance. Likelihood of CDF failure is minimized as long as regular monitoring and maintenance is conducted.	Likelihood of CDF failure is minimized as long as regular monitoring and maintenance is conducted.	Same as Alternative SW-8
Implementation			
o Technical Feasibility	Equipment and technology exists for capping. However, cap installation may be difficult since conventional placement techniques would need to be modified to accommodate the shallow water depths in the upper estuary. CDFs are relatively easy to implement. Dredging and CDF disposal are well-proven technologies.	CDFs are relatively easy to implement. Dredging and CDF disposal are well proven technologies.	Same as Alterntive SW-8. Incineration or solvent extraction would require special equipment and operations; treated residuals would require testing to verify treatment effectiveness. Incineration has been demonstrated at other sites. Demonstrations of full-scale solvent extraction have been limited. Technology has been demonstrated on a bench-scale to be effective at treating New Bedford Harbor sediments.
o Administrative Feasibility	Expected to be feasible. On-site remediation will negate need for permits.	Same as Alternative SW-7	Same as Alternative SW-7
o Availability of Services and Materials	Dredge cap and CDF construction services available in eastern U.S.	Dredge and CDF construction services available in eastern U.S.	Same as Alternative SW-8. Incineration equipment equipment and services available in eastern U.S.

TABLE 3-1
Continued

ASSESSMENT FACTORS	ALTERNATIVE SW-7	ALTERNATIVE SW-8	ALTERNATIVE SW-9
COST			
o Present Cost	$36,164,000	$33,274,000	$ 80,634,000 (SW-9A) $ 92,999,000 (SW-9)
Compliance w/ARARs	AWQC for water column PCB concentrations would not be attained at the end of ten years following remediation. FDA tolerance level for biota would not be attained in all areas. Waiver from action-specific ARAR may be required for unlined CDFs. All other ARARs would be met.	AWQC for water column PCB concentrations would be attained at the end of ten years following remediation. FDA tolerance level for biota would not be attained in all areas. Waiver from action-specific ARAR may be required for unlined CDFs. All other ARARs would be met.	Same as Alternative SW-8
Overall Protection of Human Health and the Environment	Risks to human health and the environment are reduced by minimizing contact with contaminated sediment through capping and by the removal of the sediments.	Risks to human health and the environment are reduced by minimizing contact with contaminated sediments through removal of the sediment.	Same as Alternative SW-8. Risks to human health and the environment are significantly reduced by the removal and treatment of sediments containing PCBs > 500 ppm.

However, no permanent reduction in risk would be achieved for these alternatives since a failure of the containment component could re-expose humans and aquatic biota to contaminated sediment and the associated risk.

SW-9, which employs treatment of PCB contaminated sediment, would provide the greatest degree of long-term effectiveness and permanence for sediment containing PCBs >500 ppm. Treatment of the sediment using solvent extraction, although not proven at full-scale, is expected to be effective in removing PCB contamination from the sediment. Incineration is a well-proven technology for treating PCB contaminated sediment. Both treatment options include components for the management of residuals (i.e., PCBs and metals) using solidification which has been demonstrated to be effective for treating organics and metals.

No long-term residual risk associated with sediment resuspension during dredging of the contaminated sediment is expected following implementation of these alternatives.

A residual risk would remain after implementation of any of the alternatives evaluated due to the 50-ppm TCL chosen for remedial action. Because of this residual risk, all the alternatives require institutional controls, a long-term monitoring program, and five-year reviews. The long-term effectiveness of each alternative depends on the reliability of these programs.

3.3 REDUCTION IN MOBILITY, TOXICITY, AND VOLUME

This criterion evaluates the degree to which a remedial alternative permanently and significantly reduces the mobility, toxicity, or volume of the contaminant as a direct result of treatment. Of the three site-wide alternatives, only SW-9 achieves a permanent reduction in the mobility, toxicity and volume of PCBs through treatment of sediment containing PCBs >500 ppm and above. All three site-wide alternatives employ remedial actions which would contain PCB contaminated sediment either in CDFs or under a cap. Thus, a reduction in migration potential of the contaminants may be acheived. The permanency of this action is not known since insufficient data exits to assess long-term performance of CDFs and caps.

3.4 IMPLEMENTABILITY

The implementability of an alternative includes the technical and administrative feasibility of implementing the alternative, as well as the availability of the technology. All three site-wide alternatives would entail sediment dredging, CDF construction, and water treatment. The capping component in Alternative SW-7 would also entail the placement of geotextile and cap material. The technology, equipment and personnel needed to implement these unit processes has been proven reliable and is readily available. Alternative SW-8 would be the easiest to implement. This alternative would employ conventional dredging equipment and techniques to remove the contaminated sediment and conventional land-based excavation equipment to build the CDFs for sediment disposal.

Alternative SW-7 may be the hardest to implement due to the unique site conditions found in New Bedford Harbor. Capping of contaminated sediment in relatively shallow depths such as found in the upper estuary has not been demonstrated to date. Conventional material placement techniques would have to be modified for cap placement and a hydraulic control system would need to be installed at the Coggeshall Street Bridge to ensure adequate water depth in the upper estuary for efficient installation of the cap.

Alternative SW-9, which includes a treatment component using either incineration or solvent extraction, may present difficulties in implementation due to availability of treatment equipment and/or the ability of the treatment equipment to meet performance specifications established for treating New Bedford Harbor sediment. Mobile or transportable incinerators for the destruction of PCBs in solid matrices (e.g., soils, sludges, or sediments) are available and have been demonstrated capable of meeting the required 99.9999% destruction efficiency mandated by TSCA regulations. However, test burns of the selected incinerator design would need to be conducted to demonstrate this level of performance for treating New Bedford Harbor sediment. Specialized solvent extraction equipment would also need to be mobilized to the site and tested before full-scale operation. Because this is an innovative technology and commercially avialable equipment is limited, the equipment may need to be scheduled or constructed before mobilization.

3.5 COST

Costs for the three site-wide alternatives are discussed in Section 2.0. The present worth of each alternative is summarized in ascending order as follows:

ALTERNATIVE	ESTIMATED COST
SW-8	$33,274,000
SW-7	$36,164,000
SW-9A (w/solvent extraction)	$80,634,000
SW-9 (w/incineration)	$92,999,000

Figure 3-1 graphically illustrates the comparative costs of the alternatives.

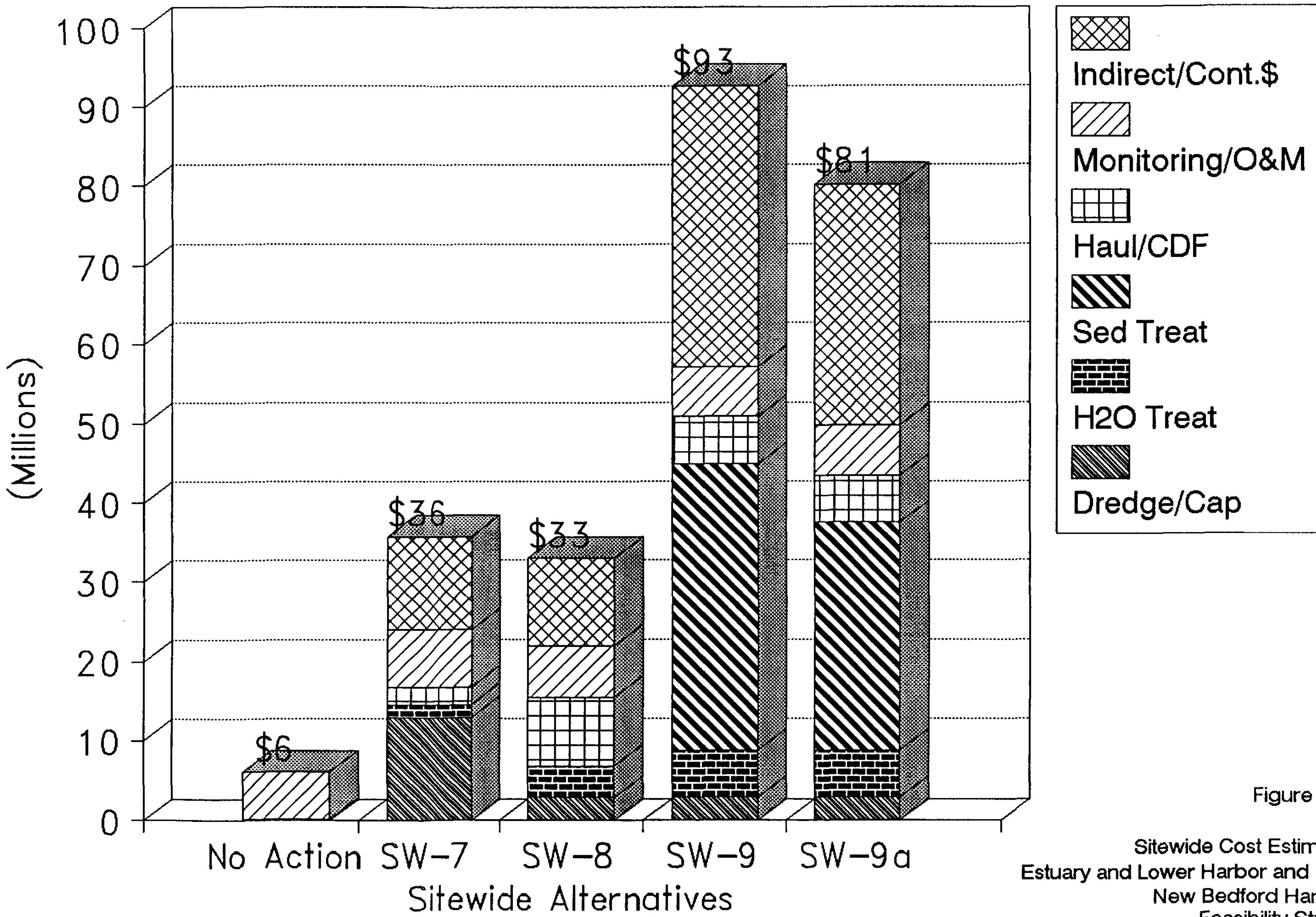


Figure 3-1

Sitewide Cost Estimate
Estuary and Lower Harbor and Bay
New Bedford Harbor
Feasibility Study

3.6 COMPLIANCE WITH ARARs

This criterion evaluates the alternatives on the basis of how they would comply with chemical-specific, location-specific, and action-specific ARARs. For chemical-specific ARARS, it is anticipated that the AWQC for water column PCB concentrations at the end of ten years would not be attained for Alternative SW-7, but would be attained for Alternatives SW-8 and SW-9. All three site-wide alternatives would not attain the FDA tolerance level of 2 ppm for biota in all areas. All three alternatives would comply with location-specific ARARs applicable to the wetlands and floodplains of the estuary and the lower harbor/bay. All three alternatives would comply with action-specific ARARs triggered by dredging, disposal, and dewatering of contaminated sediments with the exception of the Massachusetts Hazardous Waste Regulations (310 CMR 30.00) which are relevant and appropriate to the design, construction, and O&M of the CDFs. To comply with 310 CMR 30.00, the CDFs would need to achieve a minimum permeability standard of $1x10^{-7}$ cm/sec. Alternatives SW-7, SW-8, and SW-9/9A do not include a liner as part of CDF construction. Therefore, a waiver of this ARAR may be required.

Site activities for all three alternatives, including monitoring, would be carried out pursuant to OSHA standards (29 CFR 1904, 1910, and 1926) and Massachusetts Right-to-Know regulations.

3.7 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall protection of human health and the environment is a primary, or threshold, criteria that must be met by any alternative in order for it to be eligible for selection. All three of the site-wide alternatives would provide additional protection to human health and the environment over baseline conditions.

All three site-side alternatives incorporate containment of contaminated sediment in the estuary and the lower harbor and bay areas by capping or disposal in shoreline CDFs. This would effectively reduce the potential for direct contact exposure and would limit the source of PCB contamination in surface water and biota. Reduction of shoreline sediment PCB concentrations to 50 ppm would provide an adequate level of protection to human health and a significant reduction in ecological risks over baseline conditions. The 50 ppm TCL is protective of older children and adults from direct contact exposure to sediments. Because young children are considered the most sensitive population, the risks associated with a 50 ppm TCL are greater than for older children and adults at $5x10^{-5}$. However, the risk level for the 50 ppm TCL is within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Significant reductions in the MATCs for aquatic biota such as marine fish, mollusks, crustaceans, and algae would be achieved for a 50 ppm TCL at the end of ten years following implementation of any of the site-wide alternatives. Residual PCB concentrations in lobster and flounder would not be expected to fall below the 2 ppm FDA tolerance level in all areas while the residual PCB concentrations in lower food chain species such as hard clams, mussels, and crabs would be expected to fall below the FDA tolerance level. However, all residual PCB concentrations in these species would remain in excess of the human health-based 0.02 ppm RTL.

Short-term ecological impacts are expected. Benthic biota residing in the sediment would essentially be destroyed during dredging of the estuary and the lower harbor/bay and the time required to fully recolonize these areas is not known.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ARARs	applicable or relevant and appropriate requirements
AWQC	ambient water quality criteria
BACT	Best Available Control Technology
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeters
CSO	combined sewer overflow
CWA	Clean Water Act
cy	cubic yards
CZM	Coastal Zone Management (Massachusetts)
DRE	destruction and removal efficiency
EPA	U.S. Environmental Protection Agency
FDA	U.S. Food and Drug Administration
FS	Feasibility Study
gpd	gallons per day
g/sec	grams per second
kg	kilograms
kg/yr	kilograms per year
MADEP	Massachusetts Department of Environmental Protection
MATC	Maximum Acceptable Toxicant Concentration
MCP	Massachusetts Contingency Plan
mg	milligrams
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MLW	mean low water
m/sec	meters per second
NCP	National Contingency Plan
NEPA	National Environmental Protection Act
ng/cm	nanograms per cubic meter
ng/L	nanograms per liter
NOI	Notice of Intent
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration

GLOSSARY (Continued)

PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RTL	Residual Tissue Level
SARA	Superfund Amendments and Reauthorization Act
TCL	Target Clean-up Level
TCLP	Toxicity Characteristic Leaching Procedure
TEA	triethylamine
TSCA	Toxic Substances Control Act
ug/g	micrograms per gram
ug/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
UV	ultraviolet

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